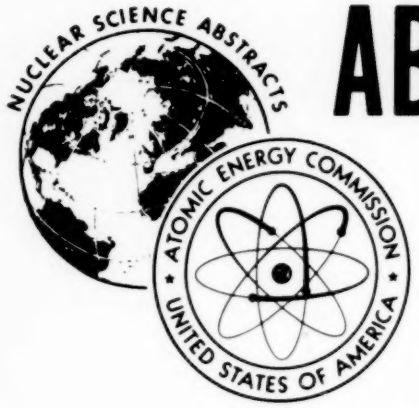
NUCLEAR SCIENCE ABSTRACTS



Volume 25 Number 11

Abstracts 23501-26149

June 15, 1971

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Volume 25, Number 11, June 15, 1971

NUCLEAR SCIENCE ABSTRACTS

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Each author's name is indexed in the form appearing on the document abstracted:

ISHIHARA, T., Accumulation of fallout ^{137}Cs in newborn infants, 23:50538
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MELPHALAN
  effects on proliferation of cultured antigen-stimulated spleen cells from mice, dose-response curve for, 23:50820
MEMBRANE FILTERS
  design for removal of cell-free Streptococcus faecalus from bacteria cultures in fermentation tank, 23:49996 (UCRL-18667, pp 322-9)
MENDELEVIUM
  separation from einsteinium and fermium by electrolysis, 23:49772 (UCRL-18667, pp 277-312)
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Use of funds for printing this publication approved by the Director of the Bureau of the Budget, June 26, 1969.

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Volume 25, Number 11 June 15, 1971

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical Chemistry

Refer also to abstracts 23544, 23753, and 23754.

23501 (MLM–1801) REPRESENTATIVE ANALYTICAL METHODS FOR SELECTED METAL IONS. Gillette, R. K. (Mound Lab., Miamisburg, Ohio). 12 Mar 1971. Contract AT(33-1)-Gen-53. 50p. Dep. NTIS.

The following representative analytical techniques as used for certain metallic ions are recorded in detail: spectrophotometry, neutron activation analysis, atomic absorption spectrophotometry, fluorescence analysis, emission spectroscopy, photometric titration, solvent extraction, ion exchange, spark source mass spectroscopy, and x-ray emission analysis. Wherever possible concentration ranges, interferences, sensitivity, accuracy and precision data are included. Suggested improvements on certain analytical techniques that may remove interferences in some current methods as well as improve accuracy and precision in various measurements are given. (auth)

23502 BARIUM AND STRONTIUM IN SILICATES. A STUDY ON THE DEVELOPMENT OF ANALYTICAL METHODS. Ingamells, C. O.; Suhr, N. H.; Tan, F. C.; Anderson, D. H. (Pennsylvania State Univ., University Park). Anal. Chim. Acta; 53: 345-60(Feb 1971).

Barium and strontium in silicates were determined by a number of methods, and their contents in several standard samples are reported. Instrumental techniques evaluated include isotope dilution mass spectrometry, flame emission and absorption spectrometry, emission spectrography and spectrometry, x-ray fluorescence spectrography, and neutron activation analysis. Classical gravimetric methods are reported. Two x-ray fluorescence procedures were used; one involves fusion with lithium metaborate and yields only strontium values. The other uses a direct dilution technique and gives results for both barium and strontium. In practice, this method requires a suite of analyzed standards, which should be generally similar in composition to the unknown. Strontium can be satisfactorily determined by atomic absorption spectrometry in whole-rock solutions, but there are difficulties in determining barium in this way. Emission spectrometry, with a spark-solution technique and automated equipment, gives rapid and accurate results for both barium and strontium. Flame emission spectrometry, neutron activation analysis, and classical gravimetric methods are not satisfactory as practicable routine methods for barium and strontium in silicate rocks. Conclusions are that barium and strontium may be satisfactorily determined by several methods, and that refinement of these methods is possible to the point where sampling error, rather than analytical error, may often determine variance in the results. (auth)

Chemical and Spectral Procedures

Refer also to abstracts 23641, 23895, 23915, 23921, and 24342.

23503 (RT/CHI–(70)29) DIRECT POTENTIOMETRIC DETERMINATION OF URANIUM IN ORGANIC SAMPLES. Pompei, V.; Altamura, V. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 24 Sep 1970. 22p. (In Italian). Dep. NTIS (U. S. Sales Only).

A rapid method is described for direct potentiometric determination of uranium in the organic phase. The reduction of uranium from VI to IV with Fe^{2+} is carried out in a phosphoric acid medium and uranium (IV) is subsequently titrated with $K_2Cr_2O_7$ in the presence of phosphoric acid in a heterogeneous medium. The equivalent point is registered by means of a potentiograph recorder. The possibility of titrimetric determination of uranium(IV) by back-titration with $FeSO_4$ is also described. (auth)

23504 SPECTROPHOTOMETRIC DETERMINATION OF ANIONS BY SOLVENT EXTRACTION WITH NEUTRAL RED. Tsubouchi, M. (Tottori Univ., Japan). Anal. Chim. Acta; 54: 143-8(Mar 1971).

Spectrophotometric methods are proposed for the determination of anions such as thiocyanate, perchlorate, and iodide. The methods are based on solvent extraction of the ion pairs formed between colored neutral red cations and the anions into an organic solvent. Mercury(II) can also be determined by extraction of the bromomercurate(II) complex with neutral red. Calibration graphs were linear in the range 10^{-6} to 10^{-5}M for each anion or mercury (II) in aqueous solution. Optimal conditions for the extraction and the composition of the extracted species are described. (auth)

23505 DETERMINATION OF TELLURIUM BY ATOMIC ABSORPTION SPECTROMETRY IN ANTIMONY–GALLIUM SEMICONDUCTOR ALLOYS. Uny, G.; Tardif, J. P.; Spitz, J. (CEN, Grenoble, France). Anal. Chim. Acta; 54: 91-6(Mar 1971). (In French).

Tellurium, used as dopant in semiconductor materials of the Ga–Sb type, was determined without separation by atomic absorption spectrophotometry. The sample is converted to liquid chlorides by attack with chlorine gas, and is then nebulized in a heated spray chamber before introduction into the burner. The improvement brought by this heated spray chamber allows a detection limit of 0.02 μg Te ml^{-1}. (auth)

23506 DETERMINATION OF ZIRCONIUM, SILICON, PHOSPHORUS, AND ALUMINIUM [IN LEATHER]. (PROVISIONAL METHODS.). J. Soc. Leather Trades Chem.; 53: 389-99(1969).

Five separate samples are necessary for the determinations. For Zr, the sample is ashed, the residue is extracted with dilute H_2SO_4. Ti is masked with H_2O_2, and Zr is precipitated as the phosphate and determined gravimetrically after ignition of the precipitate. For Si, the sample is oxidized in a Parr or Wurzschmitt bomb under alkaline conditions, and Si is determined spectrophotometrically as the reduced molybdosilicate complex. For P, the sample is oxidized with a mixture of HNO_3, H_2SO_4, and $HClO_4$, and the P is determined spectrophotometrically as a molybdovanadophosphate complex. For Al, the sample is ashed, the residue is brought into solution by either alkaline fusion or wet oxidation, and the Al is determined by complexometric titration with 1,2-diaminocyclohexanetetraacetic acid (Xylenol Orange as indicator). (Anal. Abstr.)

23507 USE OF SILICA GEL FOR THE SEPARATION OF TRACES OF URANIUM. Sulcek, Zdenek; Sixta, Vaclav (Central Geological Survey, Prague). Anal. Chim. Acta; 53: 335-44 (Feb 1971).

A simple chromatographic procedure for separation of trace amounts of uranium was developed. From the solution containing EDTA and tartaric acid at pH 5, uranyl ions are selectively retained on a short silica gel column and are later eluted with 3M acetic acid. The uranium content is measured spectrophotometrically with Arsenazo III directly in the eluate without further pH adjustment. The effects of aluminum and thorium are discussed. The method is applied to determination of microgram amounts of uranium in rocks and underground waters. (auth)

23508 IMPROVEMENTS IN THE DETERMINATION OF ^{15}N IN THE LOW CONCENTRATION RANGE BY EMISSION SPECTROSCOPY. Perschke, H.; Proksch, G.; Keroe, E. A.; Muehl, A. (International Atomic Energy Agency, Seibersdorf, Austria). Anal. Chim. Acta; 53: 459-63(Feb 1971).

Experiments were undertaken to determine the effect of increased activation of the Dumas mixture on the accuracy and precision of ^{15}N determination by emission spectroscopy. The simple linear interpolation of the background $^{14}N-^{14}N$ band in the region of the $^{14}N-^{15}N$ peak is a satisfactory basis for measurement of the size of the latter peak and with pure nitrogen analyses for ^{15}N with a precision better than ±2% are possible in the region of natural to 1% excess ^{15}N. With proper activation of the Dumas chemicals, it is possible to obtain a sample of nitrogen from organic and inorganic nitrogenous material that is sufficiently free from impurities so that results with a precision of ±2% are possible on a routine basis from natural to 2% abundance. (M.C.G.)

23509 PREPARATION OF PELLETS FROM ION-EXCHANGE RESINS FOR DIRECT ANALYSIS FOR METAL IONS BY X-RAY SPECTROSCOPY. Blount, C. W.; Morgan, W. R.; Leyden, D. E. (Univ. of Georgia, Athens). Anal. Chim. Acta; 53: 463-6(Feb 1971).

A chelating ion-exchange resin was used in determining Ba ions in solutions of 1M NaCl containing Ca and Sr. This resin contains iminodiacetic acid functional groups that are highly selective for divalent and polyvalent metal ions. The pellet prepared from this resin was an improvement over loose resin beads. (M.C.G.)

23510 AMERICAN STANDARD: REFEREE METHODS FOR THE CHEMICAL ANALYSIS OF NUCLEAR FUELS. ANSI N 5.7 1965. New York; American Institute of Chemical Engineers (1965). 60p. Available from American National Standards Inst., New York.

The Referee Methods for determining uranium isotopes, uranium content, UO_2 stoichiometry, moisture content, fluoride and chloride, nitrogen, carbon, and impurities are given. (M.C.G.)

23511 STUDY OF THE RUTHENIUM-2,2',2-TERPYRIDINE SYSTEM. Ciantelli, Giualiano; Legittimo, Paola; Pantani, Francesco (Univ., Florence). Anal. Chim. Acta; 53: 303-8(Feb 1971).

The chemical and electrochemical behavior of ruthenium(II) and ruthenium(III) complexes with 2,2',2"-terpyridine was studied. Spectrophotometric measurements proved the existence of a protonated ruthenium(II) complex with $pK_a = 2.9$. Potentiometric and voltammetric studies showed a difference in the behavior of the ruthenium(II) complex against chemical and electrochemical oxidation. Potentiometric data showed also that the ruthenium(III) complex may be reduced rapidly and spontaneously. These complexes can be used for spectrophotometric determination of ruthenium. (auth)

23512 INFLUENCE OF THE NATURE OF THE ELECTROLYTE ON THE POLAROGRAPHIC BEHAVIOR OF RARE EARTHS. Caude, M.; Lelievre, D.; Rosset, R. (Ecole Superieure de Physique et Chimie Industrielles, Paris). Bull. Soc. Chim. Fr.: No. 12, 4554-59(Dec 1970). (In French).

The electrochemical reduction of Eu^{3+}, Yb^{3+}, and Sm^{3+} at a dropping mercury electrode by classical polarography and impulse polarography was studied. In a noncomplexing medium ($LiClO_4$), these three lanthanides are reducible in two steps. When the electrolyte is a quaternary ammonium salt, the reduction waves Eu^{3+}/Eu^{2+} and Yb^{3+}/Yb^{2+} are displaced towards negative potential. This displacement increases with the concentration of the quaternary ammonium salt and with the organic character of the tetraalkylammonium cation. Such phenomena are explained by the specific adsorption of the cations R_4N^+ at the surface of the mercury, which makes the exchange of the electrons with the electrode more difficult. The addition of tensioactive substances (Triton X 100, gelatin) which desorb the tetraalkylammonium cations decreases the over voltage of reduction. Europium and ytterbium can be easily determined at concentrations of 10^{-5}M by classical polarography, and of 10^{-7} and 5×10^{-7}M, respectively, by impulse polarography. The determination of samarium is much more delicate and sensitivity not so good (10^{-4}M by classical polarography). (auth) (France)

23513 CONTROLLED-POTENTIAL COULOMETRIC DETERMINATION OF PLUTONIUM IN THE PRESENCE OF IRON. Stokely, J. R. Jr.; Shults, W. D. (Oak Ridge National Lab., Tenn.). Anal. Chem.; 43: 603-5(Apr 1971).

The coulometric method for determination of Pu was modified to make it insensitive to relatively large quantities of iron. The modification involves addition of the disodium salt of bathophenanthroline sulfonate (BPSA) to the supporting electrolyte. Complexation of BPSA with iron shifts the formal potential of the iron couple and permits oxidation and reduction of Pu(III) and Pu(IV) without simultaneously affecting the oxidation state of iron. The relative standard deviation for 8 titrations was found to be 0.3% with a positive bias of 0.2%. (M.C.G.)

23514 NEW SPECTROPHOTOMETRIC METHOD FOR DETERMINATION OF SUBMICROGRAM QUANTITIES OF SELENIUM. Osburn, Robert L. (Louisiana State Univ., Eunice); Shendrikar, A. D.; West, Philip W. Anal. Chem.; 43: 594-7(Apr 1971).

Sulfanilamide and N-(1-naphthyl)-ethylenediamine dihydrochloride were selected for development of a new spectrophotometric method for determination of selenium. Reaction parameters such as temperature, time, and reagent concentrations were studied and optimum conditions established. The effects of various ions, including UO_2^{2-}, on the determination were determined. (M.C.G.)

23515 DETERMINATION OF YTTRIUM, EUROPIUM, TERBIUM, DYSPROSIUM, HOLMIUM, ERBIUM, THULIUM, YTTERBIUM, AND LUTETIUM IN MINERALS BY ATOMIC ABSORPTION SPECTROPHOTOMETRY. Van Loon, J. C.; Galbraith, J. H.; Aarden, H. M. (Univ. of Toronto). Analyst; 96: 47-50(Jan 1971).

A procedure is described for determining yttrium, europium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, and lutetium in zirconium and calcium rare earth silicates by atomic-absorption spectroscopy, which involves the use of a lanthanum suppressor and has potential applications to other minerals containing these interferences. Although many of the associated ingredients are found to interfere, the addition of lanthanum overcomes these problems in many instances. Sensitivities and detection limits found with the proposed procedure are given for each element. (auth) (UK)

23516 KAEMPFEROL AS A COLORIMETRIC REAGENT FOR DETERMINATION OF ZIRCONIUM. Garg, B. S.; Trikha, K. C.; Singh, R. P. (Delhi Univ.). J. Indian Chem. Soc.; 45: 522-5 (1968).

Kaempferol (3,5,7,4'-tetrahydroxyflavone) reacts with Zr in strongly acidic medium to form a yellow colored complex. The system has been studied spectrophotometrically to determine the composition and other physical constants of the complex. The two components in the complex are present in equimolar ratio. The average value of the instability constant is 2.49×10^{-5} and the apparent molar extinction coefficient at 415 nm is 26,500. The complex obeys Beer's law in the concentration range of 0.1 to 3.6 ppM of Zr. The optimum range for determination of Zr is 0.56 to 2.5 ppM. The sensitivity of the color reaction is 0.003 γ $Zr/cm^2 \equiv \log I_0/I \equiv 0.001$. The effect of foreign ions has been studied and interference due to some of them has been removed by using suitable masking agents. (Indian Sci. Abstr.)

23517 ELUCIDATION OF THE ORGANIC MATRIX FROM A URANIUM ORE. Jacobs, Max LeRoy. Fort Collins, Colo.; Colorado State Univ. (1970). 181p. University Microfilms Order No. 71-2435.

Thesis.

The carbonaceous residue contained in the Ambrosia Lake Mining District uranium ores was partially removed by solvating with an oxidizing solvent, dimethyl sulfoxide, and two types of solvolytic reductions. The carbonaceous material interspersed in the sandstone matrix is a type of coaly residue and is of a plant or humic acid origin. Analysis of ore extracts by instrumental methods, including mass spectral, infrared, ultraviolet, visible, and nuclear magnetic resonance, has characterized several organic polynuclear compounds and a series of homologous alkyl ketones. (Diss. Abstr. Int. B)

23518 QUANTITATIVE SPARK-SOURCE MASS SPECTROMETRIC TECHNIQUES FOR THE SIMULTANEOUS DETERMINATION OF THE LANTHANIDE AND ACTINIDE ELEMENTS IN MICROGRAM AND SUBMICROGRAM TRANSURANIUM. Carter, Joel Avery. Knoxville, Tenn.; Univ. of Tennessee (1970). 112p. University Microfilms Order No. 71-337.

Thesis.

Techniques were developed for analysis of certain rare earth and actinide elements in solutions containing highly radioactive transuranium elements. Advantage was taken of the high inherent resolution and sensitivity of the rf spark-source mass spectrometer in the development of qualitative and quantitative procedures where an analysis can be made on a total sample of <1 to 10 μg. Parameters for the Associated Electrical Industries' MS-702 spark-source mass spectrometer were adjusted so that mass-to-charge ratios in the range of 10 to 310 could be subjected to qualitative analysis. For quantitative assessment of impurities in a transuranium solution, relative sensitivity factors were es-

tablished with respect to erbium, the internal standard, for the rare earth elements, and for thorium, uranium, neptunium, americium, curium, berkelium, and californium. A special glove box was designed, fabricated, and used on the source end of the mass spectrometer. The relative sensitivity values for the rare earth elements were unity, and for the actinide elements, with respect to erbium, the range was from 1.61 to 2.65. The recommended actinide relative sensitivity values are: thorium, 2.65; uranium, 2.28; neptunium, 2.26; plutonium, 2.30; americium, 1.61; curium, 2.30; berkelium, 1.88; and californium, 2.1. The linearity of the erbium-spiked solution and spark-source mass spectrographic technique was demonstrated over a concentration range of 1 to 250. A reproducibility of about 3 to 4 percent over the concentration range indicated that the relative sensitivity constants were independent of concentration. The quantitative results for impurities of certain rare earth and actinide elements in a cerium sample showed an average recovery of 100 percent. The average standard deviation was 7.6% for an eleven-element mixture of Pr, Gd, Tb, Ho, Tm, Yb, Th, Np, Am, U, and Cm. The solution and spark-source method did not require any chemical separation prior to the analysis since inter-element effects were found to be negligible for this technique. The method was also applied to the analysis of lanthanum and cerium in Hastelloy N with good accuracy and reproducibility. (Diss. Abstr.)

23519 DOUBLE-CELL COULOMETRIC DETERMINATION OF ALKALI AND ALKALINE EARTH METALS. Muto, Giichi (Tokyo Univ.); Nozaki, Ken; Nonaka, Takashi. Jap. Anal.; 20: 180-7(Feb 1971). (In Japanese).

Lithium, sodium, potassium, strontium, and barium were determined by double-cell coulometry. A new double-cell in which an electrolyte was separated into upper and lower cells by a mercury layer laid on a cation-exchange membrane was used. The sample was deposited to form the amalgam at the upper face of mercury and dissolved into the lower cell. The coulometric measurement was performed by an integration of the dissolution current of the amalgam under controlled potential. The current efficiency of potassium was about 97%, and its standard deviation was less than 1%. The time for a determination was 20 minutes. (auth)

Isotope Dilution Procedures

Refer also to abstract 24247.

23520 ISOTOPE DILUTION ANALYSIS WITH THE AID OF PREPARATIVE THIN-LAYER CHROMATOGRAPHY. Schmid, K.; Riess, W.; Egger, Hp.; Keberle, H. (CIBA Ltd., Basel). pp 67-82 of International Conference on Radioactive Isotopes in Pharmacology, Geneva, 20-23 September 1967. /Waser, P. G. (ed.). New York; John Wiley and Sons Ltd. (1969).

From International Conference on Radioactive Isotopes in Pharmacology, Geneva, Switzerland. See CONF-670998.

The various methods of isotope dilution analysis can be divided into 4 groups: direct, inverse, derivative, and double. These groups are discussed. The use of inverse isotope dilution analysis in biological tracer studies is described. Five operations are involved: measurement of radioactivity of the sample, addition of carrier, isolation, purification, and measurement of amount and radioactivity of the isolated product. Examples of use of this method are given. (M.C.G.)

Radiometric and Radiochemical Procedures

Refer also to abstracts 23586, 23639, 23755, 23782, 23941, 24006, and 26077.

23521 (KFK-1128) DETERMINATION OF ^{232}U AND ^{236}Pu IN IRRADIATED NUCLEAR FUEL. Braun, H.; Moy, T. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Radiochemie). Jul 1970. 19p. (In German). (EUR-4320). Dep. NTIS (U. S. Sales Only).

The alpha-spectrometric determination of the trace isotopes ^{232}U and ^{236}Pu in irradiated nuclear fuels is described. Interfering plutonium or americium and curium isotopes with similar α energies are removed by multiple anion exchange of their nitrato and chloro complexes. Isotopic ratios for $^{232}U/^{238}U$ and $^{236}Pu/^{238}Pu$, with values from 0.4 to 42×10^{-10} and from 0.2 to 1.6×10^{-5}, respectively, were obtained for two boiling-water reactors, one heavy-water reactor, two materials-testing reactors, and one fast reactor fuel samples. The USAEC suggested upper limit for the ^{232}U content in fuels (0.11 ppM relative to ^{235}U) will be overpassed by the heavy-water reactor. The maximal permissible amount of ^{236}Pu in nuclear power sources for space applications (2 ppM relative to ^{239}Pu) will not be reached only by the heavy-water reactor. (auth)

23522 (SRARI-P-81) METHODS OF RADIOCHEMICAL DETERMINATION OF PLUTONIUM, AMERICIUM, CURIUM, CALIFORNIUM, BERKELIUM, AND FISSION PRODUCTS IN IRRADIATED MATERIALS. Gryzin, Yu. I.; Gryzina, V. V.; Levakov, B. I.; Privalova, P. A. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1970. 28p. (In Russian). Dep. NTIS (U. S. Sales Only).

Methods are presented for the radiochemical determination of plutonium, americium, curium, californium, berkelium, and nuclear fuel fission products: cerium, rare earths, zirconium, niobium, ruthenium, strontium, and cesium. For all the above elements both express-extraction and universal-precipitation methods are given. (auth)

23523 (UCRL-50986) GAS ANALYSIS RESULTS FOR PROJECT RULISON CALIBRATION FLARING SAMPLES. Smith, C. F. (California Univ., Livermore. Lawrence Radiation Lab.). 7 Jan 1971. 11p. (PNE-R-44). Dep. NTIS.

Results are presented and discussed of chemical and radiochemical analyses of seven samples taken from the produced gas from calibration flaring on August 1 and October 4 through 7, 1970, of the Project Rulison nuclear stimulation experiment. The average gas composition observed in these samples is 48.4% CO_2, 32.8% CH_4, 15.7% H_2, 1.73% C_2H_6, 0.28% C_3H_8, and 0.23% C_{4+} hydrocarbons. The most significant radionuclide observed was tritium, present in the gas at 176 picocuries per standard milliliter. Methane contains 82% of the gaseous tritium, while hydrogen (with 11%), ethane (6%) and heavier hydrocarbons contain the balance. Tritium-to-hydrogen ratios (relative to methane) in H_2, CH_4, C_2H_6, and C_3H_8 are 0.5, 1.0, 0.9, and 0.7 respectively. The ^{85}Kr concentration is 150 pCi/ml. Other radionuclides measured were present in the following concentrations: ^{14}C at 0.41 pCi/ml, ^{39}Ar at 1.4 pCi/ml, ^{37}Ar at 10.7 pCi/ml, and ^{222}Rn at 0.03 pCi/ml. The total gas volume calculated assuming a total of 960 Ci of ^{85}Kr mixed uniformly with the chimney gases, was 6.4×10^9 liters. This volume of gas could be contained in spherical void of radius 23.5 m (77 ft) at a pressure of 200 atm and a temperature of 375°F. Totals of various radionuclides measured (based on the assumed total amount of ^{85}Kr) include: 0.11 g of tritium present as "permanent" gas (corresponding to about 10% of the one-gram expected to reside in the chimney), 2.6 Ci of ^{14}C (as carbon dioxide), 42 kCi of ^{37}Ar (at detonation time), and 9.2 Ci of ^{39}Ar. The significantly lower concentration of CO_2 present in the earliest sample taken is explained in terms of a dilution effect resulting from the long-term release of inactive CO_2 in the chimney. This hypothesis predicts the observed radial gradient in CO_2 concentration. (auth)

23524 SIMPLIFIED SEMI-QUANTITATIVE RADIOMETRIC ZINC-LEAD ORE ANALYSIS. Dziunikowski, B. Rudy Metale Niezelaz.; 15: 655-9(Dec 1970). (In Polish).

The possibility of applying radioisotopic methods to laboratory zinc-lead ore analyses is examined. The sources of errors occurring in these methods are discussed, reference being made to a balanced differential filter technique used in x-ray fluorescence procedures. In the light of these facts, the physical principle of a one-filter compensation method is presented. This method has been adopted by the Cracow Geological Enterprise for rapid semiquantitative determination of zinc along with an equally simple radioisotopic absorption procedure for the determination of lead. (auth)

23525 DETERMINATION OF ^{137}Cs IN FOOD PRODUCTS. Novikova, N. Ya.; Kazakova, T. A. Vop. Pitan.; 29: 74-6(May-Jun 1970). (In Russian).

A method for the determination of ^{137}Cs in food products is described. ^{137}Cs, ^{88}Y, and ^{144}Ce were introduced into nitric acid solutions of the ash of food products. Studies were made of the behavior of these isotopes during ^{137}Cs separation with nickel ferrocyanide followed by its precipitation as hexachlorotellurite. The results showed that 75 to 90% of the ^{137}Cs precipitated with the carrier as Cs_2FeCl_6. Data on the ^{137}Cs content in food products determined by spectrophotometric and the suggested method are compared. (R.V.J.)

23526 RAPID SEPARATION OF BERKELIUM FROM RARE EARTH FISSION PRODUCTS AND TRIVALENT ACTINIDES. Overman, R. F. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Contract AT(07-2)-1. Anal. Chem.; 43: 600-1(Apr 1971).

The method described combines the anion exchange separation of Bk(IV) in 8M HNO_3-0.2M $NaBrO_3$ from Ce(IV) with extraction of Bk(IV) on an HDEHP column. After all the trivalent nuclides are eluted from the HDEHP column, the Bk(IV) is reduced and eluted with 4M HNO_3. The berkelium is sufficiently decontaminated from other actinides to permit radioassay of ^{249}Bk by beta counting. (M.C.G.)

23527 METHOD AND APPARATUS FOR MONITORING A GASEOUS ATMOSPHERE FOR RADIOACTIVE ISOTOPES INCLUDING ORGANIC IODINE COMPOUNDS. Holford, R. M. Canadian Patent 837,735. 24 Mar 1970.

Air near a nuclear reactor is monitored for radioactive isotopes including organic iodine compounds by adding a trace addition of fluorine, chlorine, or bromine so that the isotopes will be adsorbed by a charcoal-loaded filter paper. The filter paper is then analyzed for radioactivity. (F.S.A.)

23528 RADIOCHEMICAL STUDIES ON MANGANESE NODULES OF DEEP-SEA ORIGIN. Ku, Teh-lung; Broecker, Wallace S. Deep-Sea Res. Oceanogr. Abstr.; 16: 625-37(1969).

Manganese nodules from the ocean floors were analyzed for U, Th, Pa, and Ra. The U : Th ratio is quite variable and much lower than that in seawater. The U concentrations are 4 to 13 ppM, and Th 3 to 150 ppM, reflecting both geographic and depth dependence. ^{230}Th and ^{231}Pa in the outer layers greatly exceed amounts that may be supported by U present. Since ratios greater than 11 are found at the tops of deep-sea cores, the two species must become separated during sedimentary process. Decrease with depth of these isotopes allows growth rates of nodules to be determined. Distribution of these isotopes on the surface of a nodule is not uniform. Higher concentrations occur on the upper side, suggesting that they are precipitated only on surfaces in contact with seawater. Measurements of ^{226}Ra reinforce the conclusion that it migrates in sedimentary deposits. For oceans as a whole, the amount of ^{230}Th and ^{231}Pa in nodule deposits is probably no more than 5% of that generated by U dissolved in the sea. (Geophys. Abstr.)

23529 GAS–LIQUID RADIOCHROMATOGRAPHY. Hitchcock, C.; James, A. T.; Carr, A. H. (Unilever Ltd., Sharnbrook, Eng.). pp 113-19 of International Conference on Radioactive Isotopes in Pharmacology, Geneva, 20-23 September 1967. /Waser, P. G. (ed.). New York; John Wiley and Sons Ltd. (1969).

From International Conference on Radioactive Isotopes in Pharmacology, Geneva, Switzerland. See CONF-670998.

Both the discontinuous method and continuous method of gas–liquid radiochromatography are considered. The design of a radiochromatograph is described. (M.C.G.)

23530 NOVEL METHOD FOR THE DETERMINATION OF TRITIUM IN FRESHLY DISSECTED BIOLOGICAL TISSUES. Dobbs, H. E.; Land, G. M. (Reckitt and Sons Ltd., Hull, Eng.). pp 121-4 of International Conference on Radioactive Isotopes in Pharmacology, Geneva, 20-23 September 1967. /Waser, P. G. (ed.). New York; John Wiley and Sons Ltd. (1969).

From International Conference on Radioactive Isotopes in Pharmacology, Geneva, Switzerland. See CONF-670998.

Quenching in liquid scintillation counting, due to the natural color of most biological materials, can be eliminated if the sample is completely oxidized and the oxidation products quantitatively dissolved in a scintillator. A prerequisite of the oxygen flask method for large samples is the need to dry tissues before burning. Oxygen at low pressure, passed through a radiofrequency field, is streamed over the undried tissue. Volatile components of the tissue are rapidly removed. At the same time the excited oxygen reacts with the organic material of the tissue leaving an inorganic residue. The oxidation products containing the tritium are removed from the gas stream in a trap cooled with liquid nitrogen and subsequently dissolved in a liquid scintillator injected into the trap. (M.C.G.)

Activation Procedures

Refer also to abstracts 23898 and 24006.

23531 (INR–1195) COMPUTER PROGRAMME FOR ELABORATION OF ^{148}Nd MEASUREMENTS. Mikulski, A. T.; Zelenay, T. Z. (Institute of Nuclear Research, Warsaw (Poland)). 1970. 19p. Dep. NTIS (U. S. Sales Only).

Burnup of nuclear fuel may be determined by measuring the abundance of ^{148}Nd, one of the stable fission products. After the separation and activation of Nd the spectrum of ^{149}Nd is examined using a multichannel gamma-ray spectrometer. The computer program NDM for the calculation of the area under the peaks was developed in algol for the GTER computer. (auth)

23532 BORON CONTENT AND PROFILES IN LARGE LABORATORY DIAMONDS. Chrenko, R. M. (General Electric Research and Development Center, Schenectady, N. Y.). Nature (London) Phys. Sci.; 229: 165-7(8 Feb 1971).

Neutron activation and plastic particle track detectors were used to obtain boron content and boron segragation patterns in laboratory diamonds, with silicon wafers doped with boron as reference standards. Boron concentrations between 3 and 270 atomic ppM were observed. (auth) (UK)

23533 CHLORINE AND SODIUM IN ILLINOIS COALS AS DETERMINED BY NEUTRON ACTIVATION ANALYSES. Gluskoter, H. J.; Ruch, R. R. (Illinois State Geology Survey, Urbana). Fuel; 50: 65-76(Jan 1971).

Neutron activation analysis of coal samples was applied to the problem of the mode of occurrence of chlorine in coal. Both sodium and chlorine were determined on the same 1-gram portion of each coal sampled. Excess chlorine, relative to stoichiometric NaCl, was found in a number of the coals. It does not seem reasonable to postulate either sylvite (KCl) or other chlorine-bearing minerals in these coals. Therefore, the chlorine present in a form other than sodium chloride is most likely in organic combination. (auth)

23534 NEUTRON CAPTURE γ-RAY TECHNIQUES FOR IRON AND GOLD IN MIXTURES. El Kady, A. A. (Atomic Energy Commission, Cairo); Duffey, Dick; Wiggins, P. F. Anal. Chim. Acta; 54: 97-104(Mar 1971).

The feasibility of utilizing prompt γ rays from thermal neutron capture as a nondestructive technique for identification and estimation of gold in mixtures was studied. Thermal neutrons from the University of Maryland reactor and a 40-cm^3 lithium-drifted germanium detector were applied with promising results. The high-energy capture spectra for mixtures of gold and abundant elements, such as silicon, iron, calcium, and aluminum were measured. A "Capture γ-Ray Sensitivity Index" is introduced to provide an indication of relative sensitivity for detection of elements by this technique. (auth)

23535 ANALYSIS WITH A Po–Be SOURCE: THE MEASUREMENT OF PROMPT GAMMA-RAYS. Allan, D. L.; Armitage, B. H.; Spencer, W. (Atomic Energy Research Establishment, Harwell, Eng.). Anal. Chim. Acta; 53: 401-14(Feb 1971).

Measurements of prompt γ rays arising from the neutron irradiation of nineteen elements and compounds with a Po–Be source were made with a Ge(Li) detector and also a NaI(Tl) detector. The intensities of the strongest γ rays present in each substance were obtained in units of counts kg^{-1} min^{-1} Ci^{-1}. The effect on the γ intensity of the presence of moisture in a sand (SiO_2) sample was also investigated. (auth)

23536 LABELING ADULTS OF RED PALM WEEVIL (RHYNCHOPHORUS FERRUGINEUS) WITH CERIUM FOR DETECTION BY NEUTRON ACTIVATION. Rahalkar, G. W.; Mistry, K. B.; Harwalkar, M. R.; Bharathan, K. G.; Gopal-Ayengar, A. R. (Bhabha Atomic Research Centre, Trombay, India). Ecology; 52: 186-8(Winter 1971).

Adult red palm weevils (Rhynchophorus ferrugineus Oliv.) were labeled by topical application of cerium chloride ($CeCl_3$) in 90% ethanol. Marked adults were detectable by assay of radiocerium following neutron activation of excised elytra. No significant loss of cerium from marked insects occurred over prolonged periods or after repeated washing with water. This marking technique has potential application in ecological studies, especially those of long duration. (auth)

23537 RAPID, NONDESTRUCTIVE METHOD OF FLUORINE ANALYSIS BY ^{3}He ACTIVATION. Lee, Diana M.; Lamb, James F.; Markowitz, Samuel S. (Univ. of California, Berkeley). Anal. Chem.; 43: 542-5(Apr 1971).

A sensitive, nondestructive means of determining fluorine by the ^{19}F(^{3}He, 2p)^{20}F reaction with the 1.63-MeV gamma ray of 10.8-sec ^{20}F as the "signal" for fluorine is presented. Excitation functions for the ^{19}F(^{3}He, 2p)^{20}F and the ^{19}F(^{3}He,α)^{18}F reactions and the possible interfering reaction, ^{18}O(^{3}He,p)^{20}F, are given. Thin samples of LiF, Teflon, and PbF_2, and thick samples of LiF and PbF_2 mixed in platinum were analyzed. Only milligram amounts of sample are required. The accuracy is about 3 to 5%. Under reasonable irradiation and counting conditions, the detection limit is approximately 0.2 μg/cm^2 corresponding to 2 ppM in a matrix 100 mg/cm^2 thick. With better care in shielding the NaI(Tl) scintillation detectors from the gamma background in the accelerator area, the detection limit could be lowered. (auth)

23538 TIN IN SOME STANDARD ROCKS. Schmidt, Diether (Max-Planck-Institut fuer Kernphysik, Heidelberg). Earth Planet. Sci. Lett.; 10: 441-3(Mar 1971).

Neutron activation analysis was used to determine the concentration of tin in the United States Geological Survey (U.S.G.S.) diabase W-1, the six new U.S.G.S. standards G-2, GSP-1, AGV-1, PCC-1, DTS-1, and BCR-1, and in the standard tonalite T-1. Reproducibility was good for duplicate analyses, but there were differences from previously reported data. (auth)

23539 BIOLOGICAL AND PHARMACOLOGICAL APPLICATIONS OF ACTIVATION ANALYSIS. Comar, Dominique (CEA, Orsay, France). pp 91-112 of International Conference on Radioactive Isotopes in Pharmacology, Geneva, 20-23 September 1967. /Waser, P. G. (ed.). New York; John Wiley and Sons Ltd. (1969). (In French).

From International Conference on Radioactive Isotopes in Pharmacology, Geneva, Switzerland. See CONF-670998.

Technical aspects unique to the activation analysis of biological and pharmacological materials are discussed. Recent developments in medically oriented activation analysis are outlined; the availability of small cyclotrons for hospital installation is noted. Several examples of the activation analysis of biological materials are given, including analysis of trace Mn, V, and Zn. The use of activation analysis for metabolic and in vivo studies is discussed. (J.G.B.)

23540 DETERMINATION OF TRACE CONTAMINANTS IN HYDROGENATION CATALYSTS BY NEUTRON-ACTIVATION ANALYSIS. Erdey, L. (Technical Univ., Budapest); Gimesi, O.; Szabo, E.; Csajka, M. Talanta; 17: 1157-66(Dec 1970).

A neutron-activation method was developed for the determination of the active constituents and contaminants in hydrogenation catalysts. The active constituents of palladium and nickel catalysts (Pd and Ni) and Zn and Co contaminants present in small amount were determined by a direct instrumental method. A NaI(Tl) scintillator and a Ge(Li) semiconductor connected to a multichannel analyzer were used for the measurements. A computer was used to evaluate the γ spectra. Contaminants present in small amounts were also determined by means of a radiochemical separation method based on heterogeneous isotopic exchange on mercury(II) sulphide and zinc sulphide precipitates. (auth) (UK)

Inorganic, Organic, and Physical Chemistry

23541 ADVANCES IN INORGANIC CHEMISTRY AND RADIOCHEMISTRY. VOLUME 13. Emeleus, H. J.; Sharpe, A. G. (eds.). New York; Academic Press, Inc. (1970). 595p. $26.50.

This book includes four sections entitled: Zirconium and Hafnium Chemistry, Electron Spin Resonance of Transition Metal Complexes, Recent Progress in Chemistry of Fluorophosphines, and Transition Metal Clusters with II-Acid Ligands. An abstract was prepared for each of the first two sections. (B.L.M.)

For abstracts of individual sections see: 23542 and 23543.

23542 ZIRCONIUM AND HAFNIUM CHEMISTRY. Larsen, E. M. (Univ. of Wisconsin, Madison). Advan. Inorg. Chem. Radiochem.; 13: 1-133(1970).

The chemistry of Hf and Zr reported since 1960 was reviewed with reference to earlier works included where necessary to complete the picture. 611 references are cited. Data on the metal, its alloys, and many refractory compounds are not included, and only published separation processes of particular interest in certain sections of the review are included. The subject matter is organized on the basis of the metal–nonmetal bond with compounds containing a metal–oxygen bond predominating, followed by compounds containing a metal–halogen bond. (B.L.M.)

23543 ELECTRON SPIN RESONANCE OF TRANSITION METAL COMPLEXES. Goodman, B. A.; Raynor, J. B. (Univ. of Leicester, Eng.). Advan. Inorg. Chem. Radiochem.; 13: 135-362(1970).

This section of the book includes an elementary account of the theory relevant to ESR and a comprehensive survey of the results of ESR studies on compounds of transition elements. The criterion for inclusion or rejection of material was based on the likely interest an inorganic chemist might have in the species. The review covers all ions that might be described by a nominal electron configuration ranging from d^1 to d^9; however, the lanthanide and actinide elements were excluded. (735 references) (B.L.M.)

23544 HAUPTVERSAMMLUNG, GESELLSCHAFT DEUTSCHER CHEMIKER, HAMBURG, 15. BIS 20. SEPTEMBER 1969. (General Meeting of the Society of German Chemists, Hamburg, September 15-20, 1969). Hamburg: Gesellschaft Deutscher Chemiker (1969). 282p. (CONF-690972-(Absts.)).

23545 PROCEEDINGS OF THE XL MEETING OF THE ISRAEL CHEMICAL SOCIETY, THE ISRAEL CRYSTALLOGRAPHY SOCIETY, THE ISRAEL BIOCHEMICAL SOCIETY, AND THE ISRAEL INSTITUTE OF CHEMICAL ENGINEERING, HELD AT HAIFA, OCTOBER 18-20, 1970. Israel J. Chem.; 8: Suppl., 1-194(1970). (CONF-701038-(Absts.)).

Chemical Properties

Refer also to abstracts 23511, 23675, 23939, 23940, 25259, 25995, 25997, and 25999.

23546 (COO-119-242, pp 145-51) STABILITY OF PuIV-TRANSFERRIN RELATIVE TO FeIII-TRANSFERRIN. Bruenger, Friedrich W.; Stover, Betsy J.; Atherton, David R. (Utah Univ., Salt Lake City. Radiobiology Div.).

From Research in Radiobiology.

To resolve an apparent conflict in the literature concerning the relative stabilities, in physiological environment, of the complexes of Fe(III) and Pu(IV) with transferrin, specific experiments were designed to test the methods that had been used. Results confirm the greater stability of the Fe(III) complex, and further demonstrate that the utmost attention must be devoted to the choice of experimental methods in order to avoid hydrolysis of Pu(IV) and to achieve meaningful separation of constituents. (auth)

23547 (EUR-4621) MINOX: A CATALYTIC DEOXYGENATION PROCESS FOR IRRADIATED ORGANIC REACTOR COOLANTS. Lopes Cardozo, R.; Nordmeyer, H.; Langenkamp, H.; Cerutti, C. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 16 Dec 1970. 56p. Dep. NTIS (U. S. Sales Only). EUR F. Fr. 7.75.

Oxygen-containing organic compounds present in organic reactor coolants contribute to the fouling capacity of the coolant. Catalytic hydrodeoxygenation, the MINOX process, is shown to be one of the possibilities to reduce the oxygen content of organic coolants markedly. MINOX standard conditions elaborated are: 15 atm H_2 pressure, 350°C, 0.1 to 0.4 mole H_2/mole feed, LHSV = 4.5, $CoO \cdot MoO_3$ catalyst on γ-Al_2O_3 with 250 m^2/g specific surface. The process was applied with good success to OM-2, OM-D, and HB-40 coolants. Efficiencies of up to 98% were obtained for the deoxygenation of model compounds of the phenylic, carbonylic, and carboxylic types and some irradiated coolants. Besides, the activity of the process for chlorine removal is very effective. Hydrogenation, cracking, and coke formation as caused by the catalytic contacts, and the catalyst activation and regeneration possibilities were studied intensively. (auth)

23548 (INIS-mf-27) SURVEY AND STUDIES ON THE SAFETY IN CONNECTION WITH SODIUM-WATER REACTIONS. Report for the Fiscal Year 1969. (Japan Society of Mechanical Engineers, Tokyo). Mar 1970. 209p. (In Japanese). NTIS (U. S. Sales Only).

Survey and studies on the safety in connection with sodium–water reactions were commissioned to the Japan Society of Mechanical Engineers by Power Reactor and Nuclear Fuel Development Corporation. The duties of the group for this purpose, in fiscal year 1969, are to collect data and other information originating both in the country and in oversea countries on the subject, and study the experimental data and calculation codes, thereby providing basic information necessary for the design of steam generators. The following results are given: basic reaction phenomena between sodium and water and chemical and physical properties of the substances involved; major leakage phenomena, i.e., phenomena occurring when large amounts of high-pressure water rapidly enter the sodium; minor leaks that develop into the wastage of piping; and problems intrinsic in the steam generator. (INIS)

23549 (IRCH-10/70-2) COMPLEX FORMATION BETWEEN TRIVALENT TRANSURANIUM ELEMENTS AND LIGANDS WHICH CONTAIN THE PYRIDINE OR QUINOLINE RING. Al Rifai, S. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Radiochemie). Jan 1970. 42p. (In German). Dep. NTIS (U. S. Sales Only).

The stability constants of complexes of trivalent americium or curium with ligands containing pyridine or quinoline rings were investigated by ion exchange and spectrophotometry. Ligands studied include: α-picolinic acid, α-picolinic acid N-oxide, 6-methyl-2-picolinic acid, α-pyridylacetic acid, pyridine-3-carboxylic acid, pyridine-2,6-dicarboxylic acid, 8-hydroxyquinoline-5-sulfonic acid, and 7-iodo-8-hydroxyquinoline-5-sulfonic acid. (M.C.G.)

23550 (KFK-1136) FORMATION OF COMPLEX COMPOUNDS BETWEEN THE ACTINIDES AND ORGANIC LIGANDS. Eberle, S. H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Radiochemie). Oct 1970. 187p. (In German). Dep. NTIS (U. S. Sales Only).

The preparation and properties of organic complexes of the actinides are reviewed. Methods are reported for investigation of complex equilibria that are specially suitable for transuranium elements and on their calculation by a computer. (auth)

23551 (RFP-Trans-75) AMMONIATES AND AMMONOLYSIS OF URANIUM TETRACHLORIDE. Berthold, H. J.; Knecht, H.

Translated for Dow Chemical Co., Golden, Colo., from Z. Anorg. Allg. Chem.; 366: 249-64(May 1969). 23p. Dep. NTIS.

UCl_4 reacts with liquid or gaseous NH_3 under atmospheric pressure to form ammoniates, which after removal of excess ammonia at room temperature contain 7.3 to 7.5 moles of NH_3 per mole of UCl_4. Reaction of liquid NH_3 under pressure at room temperature yields ammoniates with 9 to 10 moles of NH_3. Also, a slight ammonolysis in liquid ammonia occurs. Isothermal decomposition of the ammoniates in a stream of nitrogen at 45°C leads to $UCl_4 \cdot 4NH_3$ which at higher temperatures decomposes into $UCl_4 \cdot 1NH_3$ (stable up to about 300°C). The reaction of the higher ammoniates with gaseous carbon dioxide shows that coordinatively bound NH_3 can be distinguished from "structural ammonia". Above 350°C in a stream of ammonia, UCl_4 and its ammoniates undergo ammonolyses, forming amorphous uranium(IV) amidochloride, UNH_2Cl_3. This compound is then reduced to UCl_3, which undergoes further ammonolysis via amorphous amidochlorides (UNH_2Cl_2, $U(NH_2)_2Cl$) and crystalline uranium imidochloride U(NH)Cl to pure higher uranium nitride, UN_x($x \leq 1.75$) (at 800°C). (auth)

23552 (UJV-2417-Ch) PHYSICO-CHEMICAL MEASUREMENTS ON HYDROLYTIC URANIUM PRECIPITATES UNDER AN INERT ATMOSPHERE. Progress Report, 1969. Baran, V. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). 1970. 25p. (In Czech). NTIS (U. S. Sales Only).

A brief description is given of an apparatus for research in a high-purity inert atmosphere. Magnetic susceptibility and proton magnetic resonance measurements, x-ray structural analysis, and thermal analysis of hydrolytic precipitates with various contents of U(IV) and U(VI) were carried out on this apparatus. The valency state of uranium was studied polarographically. The following preliminary conclusions can be drawn from the measurements: (1) An interaction between U^{4+} and UO_2^{2+} takes place in the precipitate, and the resulting valency state lies between U(IV) and U(VI). (2) The hydrolytic precipitate of U(IV) is a hydroxide $[U(OH)_4]_n$ with a structure near to that of UO_2. (3) The $UO_2OH \cdot 3H_2O$ complex is another chemical substance that probably exists in a dimeric form. (4) A new phase, $UO_3 \cdot 3H_2O$, was found; it was prepared by oxidation of $U(OH)_4$. (INIS)

23553 (USBM-RC-1469) SURVEY OF THE SODIUM–WATER REACTION AND REACTION PRODUCTS. Henry, Jack L. (Bureau of Mines, Albany, Oreg. Albany Metallurgy Research Center). 20 Mar 1970. Contract AT(11-1)-599. 49p. Dep. NTIS.

A literature survey was made of the more fundamental published papers concerning sodium–water reaction chemistry. The papers, most of which consider only portions of the Na–O–H system, were organized by relationship to various joins in the system. Important conclusions are outlined and the sodium–water reaction and reaction products are discussed in relation to a leak in the steam generator of an LMFBR. (36 references) (auth)

23554 PRECIPITATION OF URANIUM FROM SULPHURIC ACID SOLUTIONS WITH HYDROGEN USING UO_2 CATALYST. Zogovic, B. (Inst. for Tech. of Nuclear and Other Mineral Raw Materials, Belgrade). pp 287-96 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

Investigations were carried out on the catalytic precipitation of uranium from sulfuric acid solutions by reduction with hydrogen using uranium dioxide as a catalyst. These investigations indicated the possibility of applying this reaction for separating uranium. In the course of these investigations the influence of some factors on the rate of reaction was determined, viz: temperature; partial pressure of hydrogen; specific surface of catalyst; and initial concentration of uranium in solution. Data obtained from these investigations indicated the possibility and conditions for applying this reaction. Uranium dioxide, formed as the product of the reduction, also has a catalytic effect in the uranium reduction reaction. It was concluded that the reduction of uranium with hydrogen from sulfuric acid solutions is a first-order reaction, the activation energy of which is 9.15 kcal/mole. The reduction product has the same crystalline structure as that of uranium dioxide, UO_2. (auth)

23555 DISSOLUTION OF UO_2 AS AN ELECTRON TRANSFER REACTION. Laxen, P. A. (National Inst. for Metallurgy, Johannesburg). pp 321-30 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

In the course of a study of the fundamental aspects of the dissolution of UO_2 in acid solutions containing Fe^{3+}, a strong similarity was observed between factors affecting the dissolution of UO_2 and factors affecting many electron transfer reactions occurring in solution, particularly the $Fe^{3+} - Fe^{2+}$ exchange. For instance, in a perchlorate medium both the $Fe^{3+} - Fe^{2+}$ exchange and the dissolution of UO_2 by Fe^{3+} are strongly catalyzed by the presence of small concentrations of sulfate, while both reactions are also affected in a similar manner by the concentration of H^+ in solution. Both these effects of SO_4^{2-} and H^+ are attributed to the formation of certain Fe^{3+} ionic species, whose concentrations appear to be rate determining in both reactions. From a comparison of the results previously reported in studies of relevant homogeneous reactions and results obtained in the present study of the dissolution of UO_2, the type of reaction occurring and the mechanism of reaction at the UO_2 surface is discussed. (auth)

23556 NEW GROUP OF HETEROPOLYCOMPOUNDS OF U(IV). I. URANIUM(IV) OCTOTUNGSTEN ANION, SYNTHESIS OF ITS ALKALI SALTS AND DETERMINATION OF THEIR BASICITY. Ripan, Raluca; Botar, A. (Chemical Inst., Cluj). Rev. Roum. Chim.; 15: 1529-35(Oct 1970). (In German).

A new group of heteropolytungstates with U(IV) as the central ion was synthesized with the general formula $Me_4[UW_8O_{28}] \cdot XH_2O$, where Me = Na^+, K^+, Rb^+, Cs^+, and NH_4^+. Chemical and thermogravimetric studies were made on these salts and their physical and chemical properties investigated. The acid, $H_4[UW_8O_{28}]$, was produced in aqueous solution with the help of ion-exchange chromatography and the basicity determined by conductometric titration with monovalent thallium acetate. The basicity is 4, the same as the alkali metal salts. (tr-auth)

23557 NEW GROUP OF HETEROPOLYCOMPOUNDS OF U(IV). II. PHOTOCOLORIMETRIC STUDIES OF THE FORMATION OF $[UW_8O_{28}]^{4-}$ IN RELATION TO pH, TEMPERATURE, AND TIME. Ripan, Raluca; Botar, A. (Chemical Inst., Cluj). Rev. Roum. Chim.; 15: 1537-41(Oct 1970). (In German).

The pH range and the optimal yield of $[UW_8O_{28}]^{4-}$ in relation to pH, time, and temperature of the reaction between WO_4^{2-} and U^{4+} were determined. The highest yield was obtained with a sodium tungstate solution at pH = 6 to 8. The yield of $[UW_8O_{28}]^{4-}$ changed very little with time and temperature. (tr-auth)

23558 STUDIES DIRECTED TOWARD THE SYNTHESIS OF CIS- AND TRANS-2-MERCAPTOCYCLOPROPYLAMINES FOR EVALUATION AS RADIATION-PROTECTIVE AGENTS. Lu, Matthias Chi-hwa. Columbus, Ohio; Ohio State Univ. (1969). 163p. University Microfilms Order No. 70-14,066.

Thesis.

To study stereochemical requirements and to differentiate between possible mechanisms of action of radioprotective agents a synthetic program designed to produce structurally rigid analogs of β-mercaptoethylamine (MEA) and γ-mercaptopropylamine (MPA) was initiated. Utilization of methyl-β-(acetylthio)acrylates and diazomethane afforded pyrazole derivatives and no cyclopropane compounds. Reaction of vinylthioacetate with ethyl diazoacetate afforded many products including the desired cyclopropane derivatives. However, these cyclopropane derivatives were not easily purified and were unstable under basic conditions; such conditions are necessary for subsequent reaction steps. A synthetic sequence that involves use of the tetrahydropyranyl ring as a protecting group was utilized. 2-Vinylthiotetrahydropyran undergoes reaction with ethyl diazoacetate affording the cis and trans-2(2′-tetrahydropyranylthio)-1-carboethoxycyclopropanes, which are then converted to the desired compounds through a series of reaction steps. Most successful, reaction of 2-vinylthiotetrahydropyran with diazoacetonitrile afforded the pure cis and trans-2-(2′-tetrahydropyranylthio)-cyclopropylnitrile after chromatography; these are then readily converted to their corresponding cyclopropylmethylamine derivatives. During the course of these investigations an allylic sulfonium ylide rearrangement was observed. A mechanistic interpretation of the reaction is presented. Long-range coupling through sulfur between the cyclopropane ring proton and the tetrahydropyranyl ring with the trans-cyclopropane series was also studied; little or no coupling was found in the cis-isomers. These data are rationalized in terms of a preferred conformation of the tetrahydropyranyl ring. (Diss. Abstr. Int., B)

23559 INVESTIGATION OF KINETICS OF CHLORINATION OF URANIUM(IV) OXIDE WITH ELEMENTARY CHLORINE. Gat, U.; Hoerbe, R. (Kernforschungsanlage GmbH, Juelich, Ger.). Atomkernenergie; 17: 55-62(Feb 1971). (In German).

The kinetics of reaction of U(IV) oxide with Cl_2 in a strongly reducing atmosphere (CO) were studied by a gravimetric method. The probes were either sintered materials or oligocrystals. Three main temperature zones are distinguished: In the low temperature range covering layers of UO_2Cl_2 are formed that hinder further reaction. Above the melting point of the oxychloride (~580°C) liquid layers are formed that drop down occasionally. The reaction rate increases considerably in this range. Above approximately 800°C no covering layers are formed and high reaction rates are

achieved, linearly proportional to the chloride partial pressure. No such relation to CO pressure was detected. The suggested explanation is that the chemisorption of chloride blocks the access of the CO. Transport mechanism in the layers at low temperature is discussed. The effects of oxygen potential buildup at high temperatures, due to the prevented access of CO, are shown. This indicates the predominant step to be the discharge of oxygen ion concentration effected by defect electron concentration, which in turn is governed by the chlorine pressure. (auth)

23560 VOLTAMMETRY OF NEPTUNIUM(VI)-PROPIONATE COMPLEXES AT THE ROTATED GLASSY CARBON ELECTRODE. Plock, C. E. (Dow Chemical Co., Golden, Colo.). Anal. Chim. Acta: 53: 249-57(Feb 1971).

The voltammetry of the neptunyl propionate complex was investigated over varying conditions of ligand concentration and pH. A reversible one-electron wave was obtained in all propionate concentration ranges investigated over the pH range 0.0 to 6.0. The half-wave potential was independent of the pH in the range 0.0 to 1.7, but was a function of the pH in the ranges 1.7 to 3.9 and 3.9 to 6.0. The limiting current was independent of the pH in the range 0.0 to 3.9, but was a function of the pH above 3.9. The maximum metal: ligand ratio was found to be 1: 3 by conductometric and amperometric titrations. The diffusion coefficient was $0.56 \cdot 10^{-5}$ cm^2 sec^{-1} at pH 2.5 and $0.50 \cdot 10^{-5}$ cm^2 sec^{-1} at pH 5.5. (auth)

23561 SPECULATIONS ON THE CHEMISTRY OF SUPERHEAVY ELEMENTS SUCH AS Z = 164. Penneman, R. A. (Los Alamos Scientific Lab., N. Mex.); Mann, J. B.; Joergensen, C. K. Chem. Phys. Lett.; 8: 321-6(15 Feb 1971).

Relativistic Hartree–Fock calculations for different ionic charges of element 164 are compared with the theory of hydration differences and various other chemical arguments about specific ligands, and the most common oxidation number should be 164(II) in contrast to 184 varying from (IV) with eight to (XII) with no 6g-electrons. (auth)

23562 DETERMINATION OF THE NUMBER OF ELECTRONS IN THE REDUCTION OF U(VI) ON A DROPPING MERCURY CATHODE IN PHOSPHORIC ACID SOLUTIONS OF VARIOUS CONCENTRATIONS. Kurbatov, D. I.; Korteva, Z. P. Tr. Inst. Khim., Akad. Nauk SSSR, Ural. Filial; No. 17, 190-4(1970). (In Russian).

The process of reducing hexavalent uranium in phosphoric acid solutions of various concentrations is irreversible. The method of polarographic coulometry, as well as an investigation of the relationship log k vs E, shows that hexavalent uranium in phosphoric acid solutions with acid: water ratios of 8: 2–2: 9 (by volume) is reduced in a single stage with participation of a single electron yielding pentavalent uranium. (JPRS)

23563 KINETICS OF THERMAL DECOMPOSITION OF UO_3. II. β–UO_3. Dharwadkar, S. R.; Karkhanavala, M. D. (BARC, Bombay). J. Indian Chem. Soc.; 45: 490-5(1968).

The kinetics of thermal decomposition of β–UO_3 was studied using thermogravimetry and differential thermal analysis techniques. Unlike the α form, β–UO_3 decomposed directly to U_3O_8. The decomposition followed first order kinetics. The specific reaction rate constant, K_r, could be expressed in terms of the activation energy and the pre-exponential factor by the equation: $Kr\ (sec^{-1}) = 7.25 \times 10^{19} \exp(-89{,}300/RT)$. (Indian Sci. Abstr.)

Isotope Effects and Exchange

Refer also to abstracts 23615, 23700, 24247, and 24577.

23564 ISOTOPIC EXCHANGE REACTIONS INVOLVING ALCOHOLS, KETONES, AND DEUTERIUM ON SILICA, ON PALLADIUM/SILICA, AND ON ALUMINA. Patterson, William R.; Burwell, Robert L. Jr. (Northwestern Univ., Evanston, Ill.). J. Amer. Chem. Soc.; 93: 833-8(24 Feb 1971).

The following two reactions, (I) i-C_3H_7OD + butanone = i-C_3H_7OH + butanone-d and (II) alcohol-ketone interchange, 2-propanol + butanone = acetone + 2-butanol, were catalyzed by a commercial silica at impurity centers, perhaps Al^{3+}. Reaction I is about 100 times as fast as (II) at 100 to 150°C. Reaction II involves a rate-limiting hydride transfer as tested by use of 2-propanol-2-d. Reactions I and II are very much slower on pure silica. Both reactions occurred on a commercial palladium/silica catalyst at roughly the same rate as on commercial silica. The reactions must occur in part on the support, but palladium metal is also active for reactions I and II. In addition, isotopic exchange between deuterium and the hydroxyl hydrogen atoms of ethanol, 2-butanol, and tert-butyl alcohol on palladium/silica is about as rapid as reaction I. Isotopic exchange between butanone and deuterium is nearly as rapid. The rate of dehydrogenation of 2-butanol to butanone is only about 0.0001 that of formation of ROD. In addition, skeletal exchange of 2-butanol occurs on palladium/silica at a rate about 0.01 that of formation of ROD. Compared with platinum and nickel, palladium appears to have a low tendency to cleave the H–COH bond of secondary alcohols but a high tendency to cleave the HCO–H bond. (auth)

23565 ISOTOPIC EXCHANGE REACTIONS INVOLVING ALCOHOLS, KETONES, AND DEUTERIUM ON COPPER CATALYST. Patterson, William R.; Roth, Jerome A.; Burwell, Robert L. Jr. (Northwestern Univ., Evanston, Ill.). J. Amer. Chem. Soc.; 93: 839-46(24 Feb 1971).

At 135°C, addition of acetone, 2-butanol, or tert-butyl alcohol at 0.1 atm to a mixture of hydrogen and deuterium at 1 atm reduces the rate of formation of HD on copper containing 1% nickel to one-fifth of its initial value. Removal of the organic compound rapidly restores the initial rate. Desorption of HD is fast enough to keep the ratio $^*D/^*H$ large during exchange between deuterium and 2-butanol under similar conditions. Relative rates are 1.00 for exchange at carbon 2, 0.2 for exchange at hydroxyl, about 0.05 for exchange at carbons 1 and 3, and 0.4 for dehydrogenation. Ethanol behaves similarly in exchange, but tert-butyl alochol exchanges more rapidly although only at OH. It is suggested that the slow step in dehydrogenation of 2-butanol at low conversions is the cleavage of the O–H bond and that optically active 2-butanol is racemized by roll-over of the second surface species. Butanone deactivates the catalyst much more rapidly than the other compounds. Initially, 2-butanone plus deuterium gives –CDOH– in which the OH is only 20% D labeled. Total deuterium in CH_3 and C_2H_5 of butanone and the the 2-butanol about equals that in –CDOH–. Adsorbed enolate is also involved in isotopic exchange of ketone. (auth)

23566 DEPENDENCE OF SOLVOLYTIC α-DEUTERIUM RATE EFFECTS ON THE NATURE OF THE LEAVING GROUP. Shiner, V. J. Jr.; Dowd, W. (Indiana Univ., Bloomington). J. Amer. Chem. Soc.; 93: 1029-30(24 Feb 1971). (COO–1008-13).

The solvolysis of 3-pentyne-2-toluenesulfonate, bromide, and iodide was studied in H_2O–ethanol and H_2O–trifluoroethanol solutions. The α-, β-, and δ-isotope effects in the various solvents are tabulated and compared with previously reported values. In some of the solvolysis reactions, the rate-determining step is the formation of the tight ion pair and in others it is nucleohilic attack on the tight ion pair. The noted dependence of the α-deuterium rate effect on the leaving group allows a comparison of the α-d effects of reactions involving different leaving groups and identity of subtle shifts in mechanisms. (B. L. M.)

23567 NUCLEAR MAGNETIC RESONANCE STUDIES OF CONFIGURATION AND LIGAND CONFORMATION IN PARAMAGNETIC OCTAHEDRAL COMPLEXES OF NICKEL(II). V. COMPLEXES OF ETHYLENE(DINITRILO)-N,N,N',N'-TETRAACETATE, 1,2-PROPANE(DINITRILO)-N,N,N',N'-TETRAACETATE, AND TRANS-1,2-CYCLOHEXANE(DINITRILO)-N,N,N',N'-TETRAACETATE. Erickson, L. E.; Young, D. C.; Ho, F. F.-L.; (and others) (Univ. of North Carolina, Chapel Hill). Inorg. Chem.; 10: 441-53(Mar 1971).

The PMR spectra of paramagnetic octahedral complexes of nickel(II) with ethylene(dinitrilo)-N,N,N',N'-tetraacetate (EDTA), 1,2-propane(dinitrilo)-N,N,N',N'-tetraacetate (PDTA), and trans-1,2-cyclohexane(dinitrilo)-N,N,N',N'-tetraacetate (CyDTA) are reported. The spectra are interpreted on the basis of the well-established dependence of hyperfine coupling constant upon dihedral angle. It is postulated that the in-plane axial acetate protons do not contribute to the spectra of any of the complexes, and the cyclohexane ring protons nearest the metal are also not observed. All the chelate rings are puckered, but the acetate chelate rings of $Ni(EDTA)^{2-}$ are not as puckered as those in Ni(EDDA). The out-of-plane acetate rings of $Ni(CyDTA)^{2-}$ are the most nearly planar of the acetate rings studied. It is surmised that the average ligand coordination number is between 5 and 6 with $Ni(CyDTA)^{2-}$ having a greater fraction of hexadentate species than $Ni(EDTA)^{2-}$ or $Ni(PDTA)^{2-}$. The acetate protons are found to undergo stereospecific base-catalyzed deuterium exchange; the out-of-plane acetate protons exchange about 10^4 times faster than the in-plane acetate protons, and an axial proton exchanges about three times faster than an equatorial proton. No significant nitrogen inversion was observed for $Ni(CyDTA)^{2-}$ in 1 week at 100°. However, nitrogen inversion is the mode of acetate scrambling in $Ni(PDTA)^{2-}$, while Δ,Λ conversion and nitrogen inversion contribute equally to acetate scrambling in $Ni(EDTA)^{2-}$. (auth)

23568 DYNAMICS OF ION–MOLECULE REACTIONS: N^+ AND O_2^+ WITH HYDROGEN ISOTOPES. Tsao, Chi-wing. Berkeley, Calif.; Univ. of California (1970). 125p. University Microfilms Order No. 71-857.

Thesis.

An ion-beam scattering-cell technique was employed in these

studies directed toward complex formations in ion-molecule reaction. The reaction N+(H2,H)NH+ is exothermic by 0.6 eV. Between an energy range of 2.5 to 8.2 eV no evidence of a complex is observed; direct reaction mechanism dominates instead. Reaction maps and velocity spectra are made for the product NH^+. The kinematic data can easily be interpreted in terms of a reaction energy level diagram. The formation of some of the electronic states as well as the ground state of NH^+ can be deduced from the experimental results. The backscattered products have a most probable velocity close to that predicted by the knockout model. A detailed study of the translational to electronic energy transfer is made between N^+ and He. Transitions like $N^+(^3P) \rightarrow N^+(^3D)$ and $N^+(^5S) \rightarrow N^+(^3D)$ are observed. The scattering data of the former transition can be explained in terms of a curve crossing model. The reaction $O_2^+ + H_2$ is studied in the energy range 1.47 to 12 eV. Four reaction channels are observed leading to the products O_2H^+, OH^+, H_2O^+, and O^+. These reactions are endothermic. Intensity contour maps and velocity spectra are prepared for all the products. At low energy, all of these reactions except the formation of O^+ proceed via a complex mechanism. A gradual transition from the complex formation to a direct mechanism is observed for the product O_2H^+. H_2O^+ forms only via the complex path. A two step model involving a unimolecular decay of O_2D^+ is proposed to explain the results of both the non-reactive scattering of $O_2^+ + D_2$ and the formation of OD^+ at high energies. It is shown that the majority of O^+ comes from a collision induced dissociation of O_2^+. Isotopic studies with HD reveals that O_2D^+ and O_2H^+ react by different mechanisms. The lifetime of the complex $H_2O_2^+$ is calculated and compared to the experimental data. Intensity data from the reaction are compared to mass spectra of $H_2O_2^+$; no resemblance between these two sets of data is found. (Diss. Abstr. Int., B)

23569 KINETIC ISOTOPE EFFECT IN THE CHEMILUMINESCENT OXIDATION OF ACRIDAN BY DIBENZOYL PEROXIDE. Steenken, S. (Univ., Munich). Tetrahedron Lett.; No. 55, 4791-4(Nov 1970).

In the reaction between acridan (AH_2) and dibenzoylperoxide (DBP) yielding acridine (A) and benzoic acid, two electrons and two protons are transferred from AH_2 to DBP. A table of rate constants and quantum yields for the reaction of AH_2 with DBP at 50°C in various solvents is given. The lack of influence of radical inhibitors on the rate of product formation and the dependence of the reaction rate on the polarity of the medium were taken as evidence for a simultaneous transfer of the two electrons. The chemiluminescence quantum yield was determined as a function of hydrogen ion concentration in the pH range 0.60 to 0.85 and a graph is given. Protonated acridine was identified as the electronically excited reaction product on the basis of the identity of the chemiluminescence emission spectrum and the fluorescence spectrum of the acridinium cation. However, further experiments suggested a selective excitation of the protonated acridine, which was related to a specific configuration of the transition complex of the reaction. The total quantum yield of the reaction in PrOD–D_2O exceeds that in PrOH–H_2O by a factor of 1.3. (UK)

23570 4550 A BAND SYSTEM OF GLYOXAL. III. VIBRATION-ROTATIONAL ANALYSES FOR 11 BANDS OF $C_2D_2O_2$. Agar, D. M.; Bair, E. J.; Birss, F. W.; (and others) (National Research Council, Ottawa). Can. J. Phys.; 49: 323-7(1 Feb 1971).

Rotational analyses were carried out for 11 bands of the $^1A_u - {}^1A_g$ ($\pi^* - n$) transition of glyoxal-d_2 in absorption. Approximately 13,000 lines were assigned, and rotational and vibrational constants determined by computer methods. The following vibrational frequencies were determined: $\nu_2' = 1394.42\ cm^{-1}$, $\nu_4' = 866.52\ cm^{-1}$, $\nu_5' = 499.04\ cm^{-1}$, $\nu_7' = 217.36\ cm^{-1}$, $\nu_5'' = 537.29\ cm^{-1}$, and $\nu_7'' = 117.98\ cm^{-1}$. The bands are relatively free from perturbations with the exception of a Coriolis interaction involving the torsional vibration $\nu_7(a_u)$ and the C–C=O bending vibration $\nu_{12}(b_u)$. (auth) (Canada)

23571 CALCULATION OF H/D KINETIC ISOTOPE EFFECTS FOR THE REACTIONS OF TRIFLUOROMETHYL RADICALS WITH SiH_4. Safarik, I.; Berkley, R.; Strausz, O. P. (Univ. of Alberta, Edmonton). J. Chem. Phys.; 54: 1919-22(1 Mar 1971).

Primary and secondary kinetic isotope effects for the reactions of trifluoromethyl radicals with SiH_4 and SiD_4 were calculated within the framework of transition-state theory using a complete nine-atom model for the activated complex. The effect of variation of the applied force field was investigated. Comparison of the results with the experimentally measured values suggests the occurrence of quantum mechanical tunneling in the reactions. (auth)

23572 KINETICS OF OXIDATION OF α-HYDROXY ACIDS BY CHROMIUM(VI) AND CERIUM(IV). Radhakrishnamurti, P. S.; Behera, T. Ch. (Kahallikote Coll, Berhampur, India). Tetrahedron Lett.; No. 53, 4619-20(Nov 1970).

The oxidation of α-hydroxy acids and some of their esters (at 0.025 M $HClO_4$) in varying proportions of acetone–water mixtures was investigated. It was found that α-hydroxy acids are retarded in Ce(IV) due to a specific solvent effect, Cr(VI) involves two electron transfer and C–H cleavage with loss of proton through the ester mechanism postulated by Kwart and Francis (J. Am. Chem. Soc. 81, 2116 (1959)) and Ce(IV) oxidation is by a one electron transfer and the rate-determining step is a O–H fission as seen by the abnormalities in acetone–water mixtures. Isotope effects were determined: $k_H/k_D = 8.6$ in oxidation by Cr(VI) and 1.1 in oxidation by Ce(IV). (UK)

23573 HYDROGEN PROTOPHILIC ISOTOPE EXCHANGE IN NITROPHENYL CYCLOPROPANE. Kazbulatova, N. A.; Isaeva, G. G.; Yakovleva, E. A.; Shabarov, Yu. S.; Shatenshtein, A. I. Vestn. Mosk. Univ., Ser. II. Khim.; 11: 746-8(Nov-Dec 1970). (In Russian).

The kinetics of isotopic exchange between unequal hydrogen atoms in o- and p-nitrophenylcyclopropane molecules and tertibutanol catalyzed by tertiary potassium butylate were studied. The reactivity of these compounds in hydrogen protophilic substitution was caused by specific features of the three-membered ring with the high negative induction effect of the nitro group. (auth)

23574 KINETIC ISOTOPE EFFECTS IN METABOLIC STUDIES WITH DEUTERATED AND TRITIATED COMPOUNDS. Aebi, H. (Univ., Bern). pp 305-19 of International Conference on Radioactive Isotopes in Pharmacology, Geneva, 20-23 September 1967. /Waser, P. G. (ed.). New York; John Wiley and Sons Ltd. (1969).

From International Conference on Radioactive Isotopes in Pharmacology, Geneva, Switzerland. See CONF-670998.

Hydrogen isotope effects in biochemical and pharmacological studies are considered. It is shown that isotope effects, especially among H, D, and T, have to be considered as valuable tools in the study of the reaction mechanism and the stereospecificity of enzymes involved in redox reactions and in the transfer of one-carbon fragments. Examples are given. (M.C.G.)

23575 INFRARED STUDIES OF WATER IN CRYSTALLINE HYDRATES: $LiI.3H_2O$. Brink, G.; Falk, M. (National Research Council of Canada, Halifax, N. S.). Can. J. Chem.; 49: 347-51(1 Feb 1971).

The infrared spectra of undeuterated and partially deuterated $LiI \cdot 3H_2O$ were recorded between 4000 and 1000 cm^{-1}. The splitting of the fundamentals of isotopically dilute HDO indicates that the water molecules are distorted and form one strong, linear OH ... I^- hydrogen bond and one weak, nonlinear hydrogen bond. The nonequivalence of the two hydrogens of the water molecule disagrees with the space group $P6_3mc$-C_{6v}^4 for this hydrate, proposed on the basis of x-ray diffraction studies. It is concluded that the space group, including hydrogens, is one of lower symmetry, $P6_3$-C_6^6. The gradual broadening and convergence of the HDO fundamentals at increasing temperature is explained by increasing librational motion of the water molecules. (auth) (Canada)

23576 SOME OBSERVATIONS ON ISOTOPIC SCRAMBLINGS ACCOMPANYING ACETOLYSIS IN THE 2-NORBORNYL SYSTEM. Lee, C. C.; Hahn, Bo-Sup; Lam, L. K. M.; Woodcock, D. J. (Univ. of Saskatchewan, Saskatoon). Can J. Chem.; 48: 3831-9 (15 Dec 1970).

Evidence is presented to show that in the acetolysis of isotopically labeled exo- or endo-2-norbornyl brosylate (exo- or endo-1-OBs) in NaOAc buffered HOAc, the initially formed product, exo-1-OAc, could undergo further isotopic scrambling during its subsequent contact with the reaction medium. These scramblings in the acetate apparently involved relatively large amounts of rearrangement of the label from C-2 to -3. After partial acetolysis of exo- or endo-1-OBs-2-d, NMR analysis showed that the recovered endo-brosylate was unchanged, while the D-label in the recovered exo-brosylate has definitely rearranged from C-2 to -1 and probably also to C-6. Thus, in the acetolysis of labeled exo-1-OBs as commonly carried out in HOAc–NaOAc, isotopic scramblings could occur not only in the solvolysis reaction itself, but also prior to the reaction due to internal return giving rise to scrambled brosylate and subsequent to the reaction due to further scrambling in the initial product. Other mechanistic implications of the results are also discussed. (auth) (Canada)

23577 MICROWAVE SPECTRUM, STRUCTURE, AND DIPOLE MOMENT OF DIFLUOROPHOSPHINE BORANE. Pasinski, John P.; Kuczkowski, Robert L. (Univ. of Michigan, Ann Arbor). J. Chem. Phys.; 54: 1903-8(1 Mar 1971).

The structure of difluorophosphine borane (HF_2P-BH_3) was determined from the microwave spectra of six isotopic species.

The expected staggered conformation and C_s symmetry were confirmed. The structural parameters are: d(PH) = 1.409 ± 0.004 Å; d(PF) = 1.552 ± 0.006 Å; d(PB) = 1.832 ± 0.009 Å; d(BH_t) = 1.226 ± 0.005 Å; d(BH_b) = 1.200 ± 0.007 Å; ∠H_tBH_t = 112.7 ± 0.5°; ∠H_bBH_t = 115.9 ± 0.4°; ∠FPF = 100.0 ± 0.5°; ∠FPH = 98.62 ± 0.25°; ∠BPF = 117.7 ± 0.3°. Two angles (PBH_t = 109.9 ± 0.3°; PBH_b = 99.89 ± 0.26°) indicate a tilt of the borane group away from the fluorine atoms. The value of the dipole moment obtained from Stark splittings is 2.504 ± 0.030 D. A range for the barrier to internal rotation is estimated as 3600 to 4500 cal/mole. The change in structural parameters of HF_2PBH_3 compared to similar compounds, the stability of HF_2PBH_3 towards dissociation, and the tilted borane group are discussed. (auth)

23578 INFRARED SPECTRUM OF CRYSTALLINE CH_2Cl_2 AND CD_2Cl_2. PHASE TRANSITION AND DOUBLET STRUCTURE OF MIXED CRYSTALS. Manzelli, P.; Marzocchi, M. P.; Califano, S. (Univ., Florence). J. Chem. Phys.; 54: 1409-10(1 Feb 1971).

The differences between the infrared crystal spectrum of CH_2Cl_2 (I) and a second metastable crystal form (II) are described. From the spectra of dilute mixed crystals of CH_2Cl_2 in CD_2Cl_2 and vice versa, it was concluded that the splitting of the fundamentals in the crystal form II is not a correlation field splitting. (D.P.O.)

23579 LOW-FREQUENCY ANHARMONIC VIBRATIONS: PSEUDOROTATION, RING-PUCKERING, AND TORSIONS. Willis, James Nelson Jr. Columbia, S. C.; Univ. of South Carolina (1970). 185p. University Microfilms Order No. 70-27060.

Thesis.

The infrared spectra of silacyclopentane, 1,1-dideutero-1-silacyclopentane, and germylcyclopentane have been recorded from 4000 to 33 cm^{-1}. The infrared spectrum of 1,1-dideutero-1-germylcyclopentane has been recorded from 4000 to 200 cm^{-1}. The complete Raman spectrum of each of these compounds has been recorded and depolarization values determined. The data rule out the planar configuration for these molecules and are shown to be consistent with the twisted C_2 molecular structure. The infrared spectrum of fluorocyclobutane has been recorded in the vapor state from 4000 to 33 cm^{-1} and of the solid at −196°C from 4000 to 200 cm^{-1}. The Raman spectra of the liquid at room temperature and the solid at ~ −70°C have been recorded and depolarization values have been measured. The spectra have been interpreted on the basis of a puckered ring with only one conformer which has a plane of symmetry and belongs to the C_s point group. The Raman spectra of methyltriiodogermane (CH_3GeI_3) and perdeuteromethyltriiodogermane (CD_3GeI_3) have been recorded. The infrared spectra of the liquids were recorded from 33 to 4000 cm^{-1} and the spectra have been interpreted in detail. The interesting torsional mode was observed at 123 cm^{-1} for the "light" molecule and the three-fold barrier restricting rotation was calculated to be 1.1 kcal/mole. The infrared spectra from 4000 to 33 cm^{-1} have been recorded for CH_3AsCl_2, CH_3AsBr_2, CH_3AsI_2, and CD_3AsI_2. The Raman spectra of each of these compounds have been recorded and partial polarization values measured for CH_3AsCl_2 and CH_3AsBr_2. The observed spectra have been successfully interpreted on the basis of a pyramidal skeletal structure of C_s symmetry. The As−CH_3 torsional mode was observed in the infrared spectrum of solid CH_3AsBr_2 and the torsional barriers calculated to be 461 ± 30 cm^{-1} (1.32 ± 0.08 kcal/mole). The torsional barrier appears to be essentially independent of substitution on the metal atom. The low frequency bending modes of solid CH_3AsI_2 and CD_3AsI_2 have been found to show correlation field splitting and have been successfully explained in terms of four molecules per unit cell with a space group of C_{2h}^6. (Diss. Abstr.) (TSS)

23580 HIGH-RESOLUTION INFRARED SPECTRA OF SOME ISOTOPIC SPECIES OF CARBON DIOXIDE. Oberly, Ralph Edwin. Columbus, Ohio; Ohio State Univ. (1970). 151p. University Microfilms Order No. 70-26,343.

Thesis.

A sample of carbon dioxide enriched to 97% in oxygen-18 was used to record its absorption spectrum in the near infrared. Twenty-one bands were identified as belonging to either the $^{12}C^{18}O_2$ molecule or its related isotopic species. One band was interpreted as belonging to the $^{12}C^{17}O^{18}O$ species. Molecular parameters evaluated from the observational data allowed the determination of the structural parameters involved. The work on $^{13}C^{16}O_2$ was based on the experimental data available in the literature. Programs written for the modern electronic computers were used in obtaining vibrational constants for this isotopic species. (Diss. Abstr. Int., B)

23581 KINETICS OF HYDROGEN ISOTOPE EXCHANGE REACTIONS. PART XXI. HETEROLYTIC TRITIUM EXCHANGE BETWEEN RESORCINOL AND WATER IN THE HOMOGENEOUS LIQUID PHASE. Gold, V.; Lee, J. R.; Gitter, A. (King's Coll., London). J. Chem. Soc., B; No. 1, 32-40(1971).

The rate of tritium loss from ring-labelled resorcinol to the solvent was measured for aqueous solutions of resorcinol, containing either added hydrochloric acid or sodium hydroxide, at 13.5°C. The experimental technique involved isotopic assays of samples of water vapor in equilibrium with the solution, i.e., without disturbance of the acid-base equilibria or concentrations of solutes. The measured rate constants represent fairly closely tritium loss from the equivalent 4- and 6-positions. In the presence of acid, the first-order exchange rate constant is proportional to the concentration of hydrogen ion, indicating that exchange involves attack of hydrogen ion on the resorcinol molecule. In the presence of alkali, the first-order constant depends both on the concentration of free hydroxide ion in solution and on the concentration of free resorcinol, in an apparently complex fashion. This behavior is quantitatively accounted for by the assumption that the following pairs of catalyst acid and substrate species make detectable contributions to the observed exchange at various concentrations (H_2R ≡ resorcinol): H_3O^+ and H_2R, H_2R and R^{2-}, HR^- and R^{2-}, H_2O and R^{2-}, and probably H_3O^+ and HR^-. The corresponding second-order rate constants were evaluated by calculations based in part on a multiple regression of the first-order exchange rate constant on the stoichiometric concentration of resorcinol and various powers of the concentration of free hydroxide ion. The required values of the first and second dissociation constants of resorcinol at 13.5°C were approximately evaluated (pK_1 = 9.45, pK_2 = 11.71) the former by potentiometric titration and the latter by measurement of the catalytic effect of the disodium salt of resorcinol on the depolymerisation of diacetone alcohol. The analysis implies the observation of general acid catalysis in a system in which the substrate alone provides the components of the buffer. (auth) (UK)

Physical Chemistry

Refer also to abstract 25635.

23582 (BARC-513) KINETICS OF RELEASE OF XENON FROM SINTERED (ThO_2–0.1 PERCENT UO_2) PELLETS. Karkhanavala, M. D.; Naik, M. C.; Kaimal, K. N. G.; Chawla, O. P. (Bhabha Atomic Research Centre, Bombay (India)). 1971. 28p. Dep. NTIS (U. S. Sales Only).

Post-irradiation thermal release of fission ^{133}Xe from ThO_2–0.1% UO_2 pellets of different sintered densities (67, 79, and 90% TD) was studied in the temperature range 200 to 1250°C. The initial burst release f_0 and apparent diffusivity D′ decreased considerably in the case of 90% TD pellets, which showed an abnormal increase in the closed porosity and sharp decrease in the open porosity. Arrhenius plots log D′ VS $^1/_T$ for the steady state release of ^{133}Xe from 67 and 79% TD pellets are linear below 600°C and above 800°C but exhibit nonlinearity in the range 600 to 800°C. The apparent activation energies in the temperature range 400 to 600°C are 5.5 and 8.8 kcal/mole for 67 and 79% TD pellets, respectively. The value for the high temperature range (>800°C) are 46.8, 49, and 58 kcal/mole for 67, 79, and 90% TD pellets, respectively. Initial burst release was found to be dependent on the density and specific surface area of the pellets and the temperature. Possible mechanism of release is discussed. (auth)

23583 (KFK-1306) ABSORPTION SPECTRA OF Pu(III), Pu(IV), Pu(VI), U(IV), AND U(VI) IN NITRIC ACID AND TRI-n-BUTYL PHOSPHATE–n-ALKANE SOLUTIONS AND THEIR USE IN AUTOMATIC PROCESS CONTROL. Schmieder, H.; Kuhn, E.; Ochsenfield, W. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Heisse Chemie). Nov 1970. 84p. (In German). Dep. NTIS (U. S. Sales Only).

The absorption spectra of PU(III), (IV), (VI), U(IV) and U(VI) in the nitric acid range of about 0.3 to 8 M were measured. Characteristic peaks for the different oxidation states were selected and, using an IBM 360/65 computer, empirical functions for the relation molar extinction coefficients−nitric acid concentration were evaluated. For PU(IV) and U(VI) the spectra in 20 vol% TBP−n-alkane at different nitric acid concentrations were also taken. For all oxidation states the validity of Beer's-law was shown. For PU(IV) and U(VI) solutions the electric conductivities were measured. In connection with the spectra it was also possible to determine the nitric acid concentration by approximative calculation. Use of the spectrophotometry for in-line-analysis in Purex process and the principles of construction for a spectrophotometric in-line instrument are discussed. (auth)

23584 (TID-25671) THERMODYNAMIC OF COMPLEXING OF TRIVALENT ACTINIDE IONS BY THIOCYANATE. Final Report, August 1968−August 1970. Choppin, Gregory R. (Florida State Univ., Tallahassee. Dept. of Chemistry). Contract AT-(40-1)-3816. 13p. Dep. NTIS.

Complexation was studied by a solvent extraction technique using dinonylnaphthalenesulfonate in heptane with an aqueous phase of pH 3. Stability constants for thiocyanate complexes of lanthanides/actinides (La, Ce, Eu, Lu, Am, Cm, and Bk) were determined. The thermodynamic values for the formation of $MSCN^{+2}$ (M = Eu, Am, Cm, and Bk) media of 5M ionic strength ($NaClO_4$) are tabulated. Spectral data indicate that the complexes are outer sphere in nature. (J.G.B.)

23585 HIGH-TEMPERATURE THERMODYNAMIC PROPERTIES OF SOME URANIUM OXIDES FROM EMF MEASUREMENTS ON SOLID ELECTROLYTE GALVANIC CELLS. Marchidan, D. I.; Matei, Speranta (Centre of Physical Chemistry, Bucharest). Rev. Roum. Chim.; 15: 1491-1502(Oct 1970).

Electromotive force measurements on high-temperature galvanic cells containing solid electrolyte were made in order to obtain the thermodynamic data for uranium oxides with O/U ratio 2.125 and 2.63 at temperatures between 1073 and 1373°K. Partial molar free energies, enthalpies, and entropies of solution of oxygen in $UO_{2.125}$ and $UO_{2.63}$ and the corresponding relative integral quantities as a function of the temperature, as well as the equilibrium pressures of oxygen over the two oxides were calculated. (auth)

23586 DIRECT COUNTING METHOD FOR STUDYING THE ABSORPTION OF AQUEOUS $^{233}UO_2^{2+}$ ONTO GLASS SCINTILLATOR SURFACES. Mark, Earl Larry. Moscow, Idaho; Univ. of Idaho (1970). 89p. University Microfilms Order No. 70-27,233.

Thesis.

The adsorption of the uranyl ion, UO_2^{2+}, from aqueous solution onto a glass surface was studied using the ^{233}U isotope as a radiotracer and a cerium-activated glass scintillator disc. Adsorption was studied at various values of pH, concentration, and temperature. The activity due only to adsorbed ions was obtained by subtracting the electronic noise and the activity due to uranyl ions in the solution from the observed activity. Kinetic data was taken and fitted with a first order rate law based on Langmuir's Model. The rate constants for adsorption were in the range 1.42×10^{-3} hr^{-1} to 1.82×10^{-2} hr^{-1}. The Arrhenius activation energy of pH 2.0 was on the order of 20 Kcal/mole. The surface coverage appears to be on the order of a monolayer or less. (Diss. Abstr. Int., B)

23587 EXCHANGE OF CALCIUM, STRONTIUM, AND BARIUM IONS ON PECTIN. Kohn, R.; Tibensky, V. (Inst. of Chemistry, Bratislava). Collect. Czech. Chem. Commun.; 36: 92-100 (Jan 1971).

Exchange of Ca^{2+}, Sr^{2+}, and Ba^{2+} on pectate was examined. The interaction of these cations with carboxyl groups of pectate was estimated from the coefficient of ion exchange selectivity (K_{Ca}^{Sr}, K_{Ca}^{Ba}) and from the stability constant of the corresponding pectates (K_{Ca}, K_{Sr}, K_{Ba}). These characteristic quantities were determined by using tetramethylmurexide as auxiliary ligand. The affinity of cations for the carboxyl groups of pectate increases slightly in the sequence: calcium < strontium < barium. The results are discussed from the point of view of application of sodium or calcium pectate as a therapeutic agent for decreasing the level of radioactive strontium in an organism. (auth)

23588 ROTATIONAL ANALYSIS OF TWO MUTUALLY INTERACTING ELECTRONIC STATES OF $^1\Pi$ CHARACTER IN ThO. Bornstedt, A. v.; Edvinsson, G. (Univ. of Stockholm). Phys. Scr.; 2: 205-10(1970).

Two new electronic states of $^1\Pi$ character were found for the ThO molecule. Rotational analysis shows that there are homogeneous perturbations between the two states, and these perturbations were analyzed by computer methods. Some derived molecular constants are given. (auth) (Sweden)

23589 NATURE OF BONDING IN URANYL ION. II. INTERPRETATION OF ABSORPTION SPECTRA AND MAGNETISM OF URANYL. Jatkar, S. K. K.; Khedekar, A. V.; Mukhedkar, A. J. (Poona Univ.). J. Univ. Poona; No. 34, 67-72(1968).

The participation of 5f orbitals in the axial bonding of $[O-U-O]^{2+}$ is favored energetically and by the overlap characteristics. The equatorial bonding in UO_2^{2+} complexes is mainly of $\sigma L \rightarrow M$ type; the $\pi \perp L \rightarrow M$ type of bonding also contributes to a considerable extent. The participation of uranium f-orbitals in the UO_2^{2+} molecular orbitals explains the absorption spectra that are mainly of the type of $L \rightarrow M$ charge transfer, while the magnetic properties do not require the participation of uranium f-orbitals. (Indian Sci. Abstr.)

23590 PHYSICOCHEMICAL PROPERTIES OF MIXTURES OF HEAVY-METAL FLUORIDES. COMMUNICATION IV. FUSIBILITY DIAGRAM OF THE XENON DIFLUORIDE–URANIUM HEXAFLUORIDE SYSTEM. Ezhov, V. K.; Prusakov, V. N.; Chaivanov, B. B. This paper was summarized in At. Energ. (USSR); 28: 497(Jun 1970) as paper No. 398/5407. (In Russian).

The phase diagram of the XeF_2-UF_6 system was studied by the method of differential thermography. On the basis of the phase diagram, the stability and structure of the compound are given. (D.P.O.)

23591 PHYSICOCHEMICAL PROPERTIES OF MIXTURES OF HEAVY METAL FLUORIDES. COMMUNICATION III. PHASE DIAGRAM OF THE URANIUM HEXAFLUORIDE–NIOBIUM PENTAFLUORIDE SYSTEM. Prusakov, V. N.; Ezhov, V. K. This paper was summarized in At. Energ. (USSR); 28: 496(Jun 1970) as paper No. 397/5406. (In Russian).

Phase diagrams of the liquid–vapor and liquid–solid equilibria of the uranium hexafluoride–niobium pentafluoride system are given. In the region of low niobium pentafluoride concentrations, the system obeys Raoult's law, whereas, in the remaining range of concentrations, it has a positive deviation from ideal behavior. (D.P.O.)

23592 NATURE OF BONDING IN URANYL ION. I. PHYSICOCHEMICAL EVIDENCE. Jatkar, S. K. K.; Khedekar, A. V.; Mukhedkar, A. J. (Poona Univ.). J. Univ. Poona; No. 34, 59-66 (1968).

The chemical, optical, and magnetic properties of the uranyl ion are reviewed so as to throw light on the electronic configuration of UO_2^{2+} and the stereochemistry of UO_2^{2+} complexes. The literature survey is found to be satisfactory for the $D_{\infty h}$ symmetry of UO_2^{2+}. The spectroscopic data favor the triplet character of the lowest excited state of the UO_2^{2+} ion, giving rise to three component vibronic transitions. (Indian Sci. Abstr.)

Radiation and Nuclear Chemistry

Refer also to abstract 23544.

Radiation Effects

Refer also to abstracts 23761, 23788, and 23934.

23593 STUDY OF THE EFFECT OF IONIZING RADIATION ON POLYMERS WITH CONJUGATED BONDS DURING THE PROCESS OF IRRADIATION. Paushkin, Ya. M.; Panchenkov, G. M.; Chernykh, V. G.; (and others) (Inst. of Petrochemical and Gas Industry, Moscow). Dokl. Akad. Nauk SSSR; 192: 835-7(1970). (In Russian).

Samples of polyacetonitrile, paracyanogen, polyphenylcyanamide, polybiacetyl, polybutylcyanamide, and polybutyl cyanate were compressed at a pressure of 9000 kg/cm^2 and a temperature of 150 to 200°C to give tablets 5 mm in diameter and 1.5 to 2.5 mm thick. The ends of the tablet disk were smeared with a conductive enamel and provided with platinum leads 25 to 50 microns in diameter which were coated with a layer of gold 3 to 7 microns thick. The tablets were sealed in lead-glass ampoules, and subjected to Co-60 γ irradiation at doses up to 10^9 rads. The resistance of the samples was followed during the irradiation by calculation from the volt-ampere characteristics of the samples. The results showed that the resistance does not depend on irradiation dose (up to 5×10^9 rads) in the low-resistance samples (polyacetonitrile, paracyanogen, polybiacetyl, and polybutyl cyanate). This resistance to ionizing radiation indicates a high chemical bonding strength due to the high degree of conjugation. These materials can be used in high radiation fields. (TTT)

23594 ELECTRON SPIN RESONANCE STUDIES ON IRRADIATED HETEROGENEOUS SYSTEMS. VI. THE STRUCTURE AND REACTIVITY OF PARAMAGNETIC CENTERS IN SILICA GEL. Kinell, Per-Olof; Komatsu, Tsuyoshi; Lund, Anders; Shiga, Tetsuo; Shimizu, Akira (Swedish Research Councils' Lab., Studsvik). Acta Chem. Scand.; 24: 3265-75(1970).

The paramagnetic centers formed in silica gel γ-irradiated at 77°K were identified from ESR spectra, microwave saturation behavior, optical and thermal bleaching properties and influence of various gel pretreatments. Four main centers were formed, namely electrons trapped at oxygen vacancy sites at g = 2.0008, electrons trapped at a limited number of sites, whose nature is not at present quite clear, at g = 2.0030, hole centers trapped on the surface of the silica gel and located near to non-bridging oxygen atoms at g = 2.0070, and finally centers attributed to holes located close to ^{27}Al nuclei at g = 2.011. Carbon dioxide present during the irradiation forms CO_3^- radicals by trapping electrons liberated in the silica gel, while the g = 2.0070 centers are unaffected. This shows that in addition to a positive charge transfer to form cations and a hydrogen atom transfer, demonstrated

in previous papers of this series, an electron transfer reaction also occurs. The reaction with other electron scavengers like oxygen and nitrous oxide was found to be more complex. (auth)

Radiation Processes

Refer also to abstracts 24495 and 24673.

23595 STRUCTURE OF PRODUCTS FORMED DURING LOW-TEMPERATURE POLYMERIZATION OF γ-IRRADIATED CRYSTALLINE ACRYLONITRILE. Kotin, E. B.; Gerasimov, G. N.; Abkin, A. D. Vysokomol. Soedin., Ser. B; 12: 860-1(Dec 1970). (In Russian).

The structures of polymerized products formed during the low-temperature γ-irradiation of acrylonitrile were studied. These products are ordinarily lost after the crystals are heated to the melting point. The conjugated bonds found in the composition of cyclic groupings and inherent to the low-temperature polymerization were not present in the γ-irradiated crystals after melting. (R.V.J.)

23596 CONCERNING THE MECHANISM OF RADIATION CROSSLINKING OF POLYISOBUTYLENE IN THE PRESENCE OF p-DIVINYLBENZENE. Kim, I. P.; Mikhailov, A. I.; Barkalov, I. M. (Inst. of Chemical Physics, Moscow). Vysokomol. Soedin., Ser. B; 12: 868-70(Dec 1970). (In Russian).

Radiation linking of polyisobutylene (PIB) in the presence of p-divinylbenzene (DVB) observed during γ irradiation at 77°K was the result of post-radiation reactions at temperatures close to the polymer vitrification temperature. The active centers initiating the post-linking were very sensitive to light. The structure of EPR spectra in the PIB–DVB did not vary at higher temperatures. It was postulated that the linking following low-temperature (77°K) irradiation of PIB–DVB was induced by centers of ion origin. (R.V.J.)

23597 EFFECT OF HIGH-ENERGY RADIATION ON PLASTICS. Kunststs.-Rundsch.; 17: 386-9(1970). (In German).

Specific effects, advantages, and disadvantages of radiation processing of distinct polymers (e.g., polyethylene, Nylon, Teflon, Dacron, silicones, PVC, polyurethanes) are discussed. Application possibilities of high-energy radiations in various industrial branches (e.g., chemical, rubber, packing, coating, and textile industries) are given. (INIS)

23598 PERMEATION OF GASES THROUGH MODIFIED POLYMER FILMS. IV. GAS PERMEABILITY AND SEPARATION CHARACTERISTICS OF GRAFT COPOLYMERS OF POLYETHYLENE AND TEFLON FEP FILMS. Kanitz, Peter J. F.; Huang, Robert Y. M. (Univ. of Waterloo, Ont.). J. Appl. Polym. Sci.; 15: 67-82(Jan 1971).

The effects of γ-induced grafting styrene and acrylonitrile on polyethylene and Teflon FEP films on their gas permeation and separation properties were investigated. The time-lag method was used to determine the permeability, diffusion, and solubility coefficients of nitrogen and methane gases in the grafted films. The separation factors of nitrogen–methane gas mixtures were measured by gas chromatography. Structural and morphologic changes in the modified films were examined by density, differential scanning calorimetry, and infrared measurements. Attempts were made to relate these changes to the gas permeation and separation characteristics of the films. Modification by graft copolymerization resulted in slightly improved separation factors; however, the permeability and diffusion coefficients decreased. The experimental permeability and diffusion coefficients for gas mixtures were in good agreement with those of the pure components and could be predicted by single gas permeability and diffusion coefficients. (auth)

23599 RADIATION CURED NORBORNENE POLYMERS. Colomb, Henry O. Jr.; Trecker, David J. (to Union Carbide Corp.). U. S. Patent 3,554,886. 12 Jan 1971. Filed 4 Mar 1969.

A radiation cured norbornenyl polymer composition comprises a member selected from either backbone radiation convertible polymers containing the norbornenyl structure or pendant radiant convertible polymers containing a monovalent norbornenyl pendant to the polymer backbone. The polymers are crosslinked by exposure to ionizing or nonionizing radiation to yield insoluble products useful as coatings, films, etc. (B.L.M.)

23600 ROLE OF IONS IN THE RADIATION INDUCED POLYMERIZATION. Schneider, Christel (Univ., Cologne). Chem. Labor Betr.; 21: 337-47(1970). (In German).

A critical literature survey of the radical and ionic mechanisms and the kinetics of radioinduced polymerization is given. The existence of the anion and its role in the polymerization are guaranteed. For extremely pure and dry monomers even a small number of ions can start a rapid polymerization due to their high propagation constants. If the system contains traces of impurities the monomer ions are deactivated by reaction with these impurities. The polymerization takes place according to a radical mechanism whereby the existence of ions is completely masked. (INIS)

23601 RADIATION-INDUCED POLYMERIZATION OF TETRAOXANE IN THE SOLID STATE. Nakase, Yoshiaki; Yoshida, Masaru; Ito, Akihiko; Hayashi, Koichiro (Japan Atomic Energy Research Inst., Takasaki). J. Polym. Sci., Part A-1; 9: 465-9 (Feb 1971).

The radioinduced polymerization of tetroxane in the solid state was investigated in air and in vacuo. The polymerization rate was higher in air than in vacuo, whereas the molecular weight of the polymer obtained at high conversion in air was considerably lower than that in vacuo. A large decrease in the molecular weight with increasing polymer yield observed in air may be explained mainly by degradation during polymerization. (auth)

23602 γ-RADIATION-INDUCED IONIC POLYMERIZATION OF PURE LIQUID STYRENE. III. EFFECT OF TEMPERATURE. Potter, R. C.; Metz, D. J. (Brookhaven National Lab., Upton, N. Y.). J. Polym. Sci., Part A-1; 9: 441-63(Feb 1971).

Previously reported studies on the radioinduced ionic polymerization of styrene were extended to higher dose rates and a temperature range between 0 and 50°C. The data at 0°C are in striking agreement (up to 10^6 rad/hr) with the mechanism proposed by Williams, Okamura, et al.; on the other hand, styrene of the highest purity exhibits a very complex behavior with temperature variations, which does not agree with this mechanism. These apparent anomalies are presented and discussed. Data are also presented on the effects of adding dry oxygen or degassed water to pure styrene. (auth)

23603 RADIATION-INDUCED SOLID-STATE POLYMERIZATION OF TRIOXANE UNDER HIGH PRESSURE. Yamazawa, Yuzo; Iwai, Tadashi; Ito, Akihiko; Hayashi, Koichiro (Japan Atomic Energy Research Inst., Takasaki). J. Polym. Sci., Part A-1; 9: 257-63(Feb 1971).

The in-source polymerization of trioxane in the solid state was investigated over a wide range of temperature and pressure, i.e., from 30 to 140°C and up to 7000 kg/cm^2, respectively. In the polymerization that was carried out slightly below the melting point under pressure, the higher the pressure, the higher the rate of polymerization. The maximum rate of solid-state polymerization of trioxane occurred near the melting points, even under elevated pressure. The rate of polymerization decreased with increasing pressure at constant temperature. The shape of the time–conversion curves may be classified into two types, i.e., one that is typical of high pressure and low temperature, and the other that is typical of low pressure and high temperature. Changes in the shape of the conversion–intrinsic viscosity curves occurred coincidentally. Thus, three regions for the different "polymerization characteristic" were determined as functions of polymerization temperature and pressure. Explanations are given for the above-mentioned polymerization characteristic. (auth)

23604 IRRADIATION-GRAFTED POLYMERIC FILMS. I. PREPARATION AND PROPERTIES OF ACRYLIC ACID-GRAFTED POLYETHYLENE FILMS. Hamil, H. F.; Adams, L. M.; Harlowe, W. W. Jr.; Martin, E. C. (Southwest Research Inst., San Antonio). J. Polym. Sci., Part A-1; 9: 363-76(Feb 1971).

Graft copolymers of low-density polyethylene film and acrylic acid were prepared by the direct grafting technique. The properties of 27.4, 33.9, 41.2, and 46.4 wt % poly(acrylic acid) graft copolymer films were compared. Measurements include degree and uniformity of grafting, gel water content, degree of swelling on wetting, tensile strength, elongation, ion-exchange capacity, water-vapor transmission, and water flux and solute rejection under reverse osmosis conditions. These properties were found to vary as the composition of the graft copolymer changed; most properties were found to be a linear function of the degree of grafting. (auth)

23605 RADIATION TECHNOLOGY OF MANUFACTURING GLASS-PLASTICS. P'yankov, G. N.; Morozov, A. V.; Omel'chenko, S. I.; (and others) (Inst. of Physical Chemistry, Kiev. Inst. of Chemistry of High Molecular Compounds, Kiev). Khim. Prom. Ukr.; No. 4, 8-10(1970). (In Russian).

Production of glass plastics using electron accelerators as radiation sources is described. The operating principle is explained with an example of the manufacture of a cylindrical sheet of cross winding. The mandrel speed, feed pitch, and dose strength

are selected so that, during the time of passage of the winding section across beam cross section, the required degree of polymerization of the binder is attained. The degree of polymerization between layers wound on top of each other is regulated by the energy of the impinging radiation and beam current. The source of fast charged particles in the model setup is an accelerator with maximum electron energy of 0.4 MeV. Electrons at this energy ensure radiation polymerization of a 0.2 to 0.3 mm layer of glass–plastics. In this layer, when the density of the current of the beam is several tens of microamperes per square centimeter, dose strength of 10^6 to 10^7 rads/sec is produced. (JPRS)

23606 HARDENING OF PAINTS AND VARNISHES BY IRRADIATION WITH ELECTRONS WHICH IONIZE POLYMERS IN THIN LAYERS. Bertrand, A. Rev. Inst. Fr. Petrole Ann. Combust. Liquides; 24: 1151-76(Oct 1969). (In French).

The aspects of the method used to harden paints and varnishes by electron radiation studied are: equipment, composition of coatings, advantages, savings, and markets. This technique can be valid provided that the chemical expert determines the right surface covering to be used from the various materials. (Summ. Articles Fr. Tech. Press) (TSS)

23607 CIS ⇌ TRANS-ISOMERIZATION OF STILBENE BY ^{60}Co-γ-IRRADIATION IN PRESENCE OF ANTHRACENE. Ehrl, A. Stud. Biophys.; 13: 151-8(1969). (In German).

Cis- and trans-stilbene, dissolved in benzene, were isomerized at 25°C by ^{60}Co γ irradiation. The dose rate was 0.33 Mrads per hour; the total absorbed dose amounted to 50 Mrads. An equilibrium was reached between 45 and 50 Mrads with 79% cis- and 21% trans-stilbene. The equilibrium was shifted by anthracene. In the presence of 5×10^{-4}M anthracene the solutions contained 75% cis- and 25% trans-stilbene, in the presence of 10^{-2}M anthracene, 69% cis- and 31% trans-stilbene. The influence of anthracene was explained by fluorescence measurements. Anthracene quenched the trans-stilbene fluorescence whereby the secondary fluorescence of anthracene was excited. Trans-stilbene, therefore, loses its excitation energy by two alternative ways, either by isomerization or by energy transfer. With reference to excited trans-stilbene anthracene was an acceptor which favored the energy transfer. The trans → cis-isomerization yield therefore was reduced with an increasing amount of anthracene. The nonfluorescent cis-stilbene quenched both the benzene and the anthracene fluorescence. This additional energy transfer from anthracene to cis-stilbene explained the increase in the isomerization yield of cis-stilbene in the presence of anthracene. (auth)

Radiolysis

Refer also to abstract 23639.

23608 (CEA-CONF-1667) RADIOLYSIS OF THYMINE IN AN AERATED AQUEOUS SOLUTION. Teoule, R.; Cadet, J. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). [1970]. 18p. (In French). (CONF-700610-11). Dep. NTIS (U. S. Sales Only).

From 4th International Congress of Radiation Research, Evian, France.

The nature of 23 radiolytic substances formed during the γ irradiation of thymine in aerated aqueous solution was determined. About fifteen are still unknown. They are incorporated in a very coherent radiolytic degradation scheme for thymine. At low flux (200 rads, thymine: 2×10^{-3} M) the determination of the principal relatively stable substances was made. (tr-auth)

23609 (CEA-N-1409) PHYSICAL CHEMISTRY SERVICE. Semiannual Progress Report, January–June 1970. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jan 1971. 57p. (In French). Dep. NTIS (U. S. Sales Only).

Topics covered are: the afterglow of He* produced by excitation with intense pulses of electrons and the effects of additional elements on this afterglow; the stimulated emission produced as a result of the pulsed radiolysis of N_2; the pulsed radiolysis of NH_3; the radiolysis of aqueous solutions; a chemical dosimetric method of measuring the electron incident energy in pulsed radiolysis; the pulsed radiolysis and the flash photolysis of KIO_3 aqueous solutions; NMR study of the polymerization of solid acrylamide and acrylic acid; x ray diffraction studies of hydrated divalent fluorides and U complex fluorides; Raman studies on UF_6NO, UF_6Cs, UF_6NH_4, UF_6, XeF_6UF_5, and XeF_5AsF_6. (France)

23610 (JPRS-52467) BIOPHYSICAL, BIOCHEMICAL RESEARCH. Translation of articles from Dokl. Akad. Nauk SSSR; 194: 708-14; 723-6(1970). 17p. NTIS.

Translations of 3 papers are presented. A separate abstract was prepared for one paper. (M.C.G.)

For an abstract of an individual paper see: 23611.

23611 (JPRS-52467, pp 6-11) EPR SPECTRA OF GAMMA-IRRADIATED LYSOZYME CHLORIDE MONOCRYSTAL. Pulatova, M. K.; Pasoyan, V. G.; Kayushin, L. P.; Kravchenko, N. A. Translated from Dokl. Akad. Nauk SSSR; 194: 711-14(1970).

An abstract of this paper, prepared from the original language, appeared as NSA 25: 15670.

23612 (NP-18750) ESR STUDY OF IRRADIATED GLYCOCYAMINE. Technical Note 164. Whelan, D. J. (Defence Standards Labs., Maribyrnong (Australia)). Dec 1970. 10p. Dep. NTIS (U. S. Sales Only).

When glycocyamine, quanidinoacetic acid, is gamma irradiated at room temperature, C–H bond fission occurs and the stable free radical, $NH_2-C(=NH_2^+)-NH-CH-CO_2^-$, is trapped in the crystal matrix. The isotropic component of the α-proton hyperfine splitting in the ESR spectrum is –51.8 MHz. No ^{14}N hyperfine splitting was observed. (auth)

23613 STUDY ON THE INFLUENCE OF γ-RAY INTENSITY ON RADIOLYSIS OF VITAMIN E IN VEGETABLE OILS. Uralova, Minna. Prum. Potravin; 20: 336-7(1969). (In Czech).

Studies on ^{60}Co γ radiation effects on vitamin E in vegetable oils showed that ionizing radiation with energies of 1.17 and 1.33 MeV at dose rates of 9800, 85000, and 500000 rad/hr had a destructive effect on vitamin E in refined soybean, sunflower, and cotton seed oils. (R.V.J.)

23614 ESR STUDIES OF γ-IRRADIATED CRYSTALLINE 1-BROMOBUTANE. Bonin, Mary L.; Bonin, Michael A.; Williams, Ffrancon (Univ. of Tennessee, Knoxville). J. Chem. Phys.; 54: 2641-5(15 Mar 1971).

Radiation damage in 1-bromobutane was studied by ESR spectroscopy. The use of aligned crystals gives well-resolved spectra which can be clearly assigned to the Br_2^- center and the n-butyl radical. Other unidentifiable paramagnetic species were also produced. A quantitative interpretation of the Br_2^- spectrum in the parallel orientation gives the magnetic resonance parameters $A(^{81}Br) = 472$ G and $g = 1.992$ in satisfactory agreement with previous studies of Br_2^- in single crystals of alkali halides. The spectrum of the n-butyl radical shows equal hyperfine interaction with the two β protons and as in other studies this is interpreted in terms of anisotropic internal rotation about the $C_\alpha - C_\beta$ bond. The same two paramagnetic species can be identified in the γ-irradiated 1-bromobutane glass, but the ESR spectrum of the n-butyl radical in this case suggests that the internal rotation is frozen out and the radical adopts a nonsymmetrical configuration. Through the positive assignment of the dihalogen anion, the results provide strong confirmation of dissociative electron capture in the radiolysis of this system. (auth)

23615 ION-MOLECULE REACTIONS IN THE RADIOLYSIS OF ETHANE. Ausloos, P.; Rebbert, R. E.; Sieck, L. Wayne (National Burcau of Standards, Washington, D. C.). J. Chem. Phys.; 54: 2612-18(15 Mar 1971).

The reactions of ions generated in ethane irradiated with gamma rays were studied by analyzing the neutral products formed in reactions with ethane and with other molecules. In experiments in the presence of added $(C_2D_5)_2CDCD_3$, for example, it was found that the following reactions take place: $C_2H_5^+ + C_2H_6 \rightarrow (C_4H_{11}^+)^* \rightarrow sec\text{-}C_4H_9^+ + H_2$; $sec\text{-}C_4H_9^+ + (C_2D_5)_2CDCD_3 \rightarrow n\text{-}C_4H_9D + C_6D_{13}^+$. The intermediate $(C_4H_{11}^+)^*$ ion can be stabilized by collisions and will then undergo an undetermined reaction (neutralization or proton transfer) to give $n\text{-}C_4H_{10}$ as a product. The over-all rate constant for reaction of the ethyl ion with ethane was found to be $\leq 10^{-10}$ cm^3/molecule · sec. Similarly, it is demonstrated that the reaction $C_2H_5^+ + C_2H_6 \rightarrow C_4H_9^+$ leads predominantly to the formation of t-butyl ions under these conditions: $C_4H_9^+ + (C_2D_5)_2CDCD_3 \rightarrow (CH_3)_3CD + C_6D_{13}^+$. Supplementary experiments performed in a photoionization mass spectrometer demonstrate that ethylene ions undergo a "resonance H_2^- transfer" reaction with ethane: $C_2H_4^+ + C_2D_6 \rightarrow C_2D_4^+ + C_2H_4D_2$, with a rate constant of 1.1×10^{-10} cm^3/molecule · sec. Similarly, the ethane parent ion reacts with ethylene: $C_2H_6^+ + C_2D_4 \rightarrow C_2H_4^+ + C_2H_2D_4$. (auth)

23616 ELECTRON SPIN RESONANCE STUDY OF RADICALS PRODUCED IN IRRADIATED AQUEOUS SOLUTIONS OF AMINES AND AMINO ACIDS. Neta, P.; Fessenden, Richard W. (Carnegie-Mellon Univ., Pittsburgh). J. Phys. Chem.; 75: 738-48(18 Mar 1971).

The radicals produced by reaction of hydroxyl radicals with some amines, amino acids, and related compounds in aqueous solutions were studied by ESR. Irradiation with high-energy

electrons was carried out directly in the ESR cavity. In most cases aminoalkyl radicals were formed by hydrogen abstraction from the carbon bearing the amino group. The radicals $\dot{C}H_2NH_2$, $\dot{C}H_2NHCH_3$, and $\dot{C}H_2N(CH_3)_2$ produced from mono-, di-, and trimethylamine were observed in the pH range 7 to 13.5. In acid solutions no radicals with the expected structure $R\dot{C}HNH_3^+$ were observed. In the cases of di- and trimethylammonium ions secondary reactions leading to radicals of the type $R_2\dot{N}H^+$ take place. The radical found in acid solutions of glycine is best described by the structure $NH_3\dot{C}HCOOH$ as supported by experiments in D_2O. In alkaline solutions of all amino acids radicals of the type $H_2N\dot{C}RCO_2^-$ were observed. In the case of α-aminoisobutyric acid a different radical, probably of type $R\dot{N}H$, was also observed at pH 13 and low concentration of solute. The results are consistent with a mechanism involving the reaction $RCH_2NH_3^+ + H$ or $OH \rightarrow R\dot{C}HNH_3^+ + H_2$ or H_2O in acid solution and the two competing reactions $RCH_2NH_2 + OH \rightarrow R\dot{C}HNH_2 + H_2O$ and $RCH_2NH_2 + OH \rightarrow RCH_2\dot{N}H + H_2O$ in alkaline solution. The latter reaction must be followed by a fast secondary step, $RCH_2\dot{N}H + RCH_2NH_2 \rightarrow RCH_2NH_2 + R\dot{C}HNH_2$, which causes the disappearance of $RCH_2\dot{N}H$ in most cases. (auth)

23617 PULSE RADIOLYSIS OF OXALIC ACID AND OXALATES. Getoff, N.; Schwoerer, F.; Markovic, V. M.; Sehested, K.; Nielsen, S. O. (Danish Atomic Energy Commission, Risoe, Max-Planck-Institut fuer Kohlenforschung, Muelheim, Ger.). J. Phys. Chem.; 75: 749-55(18 Mar 1971).

Pulse radiolyses of oxalic acid and oxalates in aqueous solution were carried out. The following rate constants were determined: $k(e^-_{aq} + HC_2O_4^-) = (3.2 \pm 0.6) \times 10^9\ M^{-1}\ sec^{-1}$ and $k(e^-_{aq} + C_2O_4^{2-}) = (1.7 \pm 0.5) \times 10^7\ M^{-1}\ sec^{-1}$. With CNS^- ions as competitive solutes $k(OH + H_2C_2O_4) = (1.0 \pm 0.1) \times 10^6\ M^{-1}\ sec^{-1}$; $k(OH + HC_2O_4^-) = (3.2 \pm 0.1) \times 10^7\ M^{-1}\ sec^{-1}$, and $k(OH + C_2O_4^{2-}) = (5.3 \pm 0.3) \times 10^6\ M^{-1}\ sec^{-1}$ were also obtained. With N_2O as a scavenger for e^-_{aq} and H_2 (45 atm) for OH the absorption spectra of several radicals were obtained. Their absorption maxima are between 230 and 250 nm. Reaction mechanisms and kinetic data of the radicals are discussed. (auth)

23618 RADIOLYSIS OF COLLOIDAL SULFUR. A MECHANISM FOR SOLUBILIZATION. Donaldson, G. W.; Johnston, F. J. (Univ. of Georgia, Athens). J. Phys. Chem.; 75: 756-63(18 Mar 1971).

Colloidal sulfur suspensions having a narrow range of particle sizes were irradiated with γ rays from ^{60}Co. The particles are solubilized on irradiation and the reaction was followed by light scattering measurements. The total dose of radiation required to produce a given change in particle size in a particular suspension depends on the duration of the irradiation periods and of the waiting or recovery periods between irradiations, the temperature, and the particle concentration. At the highest dose rates studied, solubilization rates are independent of radiation intensity. The results are consistent with a mechanism in which sulfur in the solution phase undergoes reaction on irradiation and the particles dissolve as the system attempts to establish equilibrium. Reaction at the particle surface is evidently of negligible importance. The mechanism was formulated in terms of n, the particle population, D, the diffusion coefficient for the species diffusing away from the particle surface, C_s, the effective saturation concentration of homogeneously dissolved or dispersed sulfur in the liquid phase, and k_1, a pseudo-first-order rate constant for reaction on irradiation of sulfur in the liquid phase. Results indicate a value of 25°C for the product DC_s of 5.7 to 5.9×10^{-13} with D in $cm^2\ sec^{-1}$ and C_s in $g\ cc^{-1}$. It is not possible to assign unique values to D and C_s; however, results suggest that $D \sim 5.9 \times 10^{-6}\ cm^2\ sec^{-1}$ and $C_s \sim 1.0 \times 10^{-7}\ g\ cc^{-1}$. Based on the suggested mechanism for the process and the above value for C_s, the reaction rates indicate an initial G value for reaction by sulfur in the solution phase of 2.6 atoms reacting per 100 eV of absorbed energy. (auth)

23619 CHEMILUMINESCENT REACTION OF HYDRATED ELECTRONS WITH OPTICALLY EXCITED FLUORESCEIN DYES. Rodde, A. F. Jr.; Grossweiner, L. I. (Michael Reese Hospital and Medical Center, Chicago). J. Phys. Chem.; 75: 764-8(18 Mar 1971).

It was shown with a flash photolysis-pulse radiolysis technique that hydrated electrons react with a photochemical product of aqueous eosin or fluorescein in a chemiluminescent process. The emission was identified with the fluorescent state, where the intensity varies linearly with the electron pulse dose and with the square of the initial triplet concentration. It is proposed that triplet–triplet interactions lead to a loosely bound triplet–singlet complex, which reacts with e^-_{aq} to generate the excited singlet state of the monomer and the dye semiquinone. (auth)

23620 E. S. R. STUDY OF IRRADIATED GLYCOCYAMINE. Whelan, D. J. (Australian Defence Scientific Service, Ascot Vale, Victoria). Aust. J. Chem.; 24: 445-7(1971).

The structure of a free radical trapped in γ-irradiated glycocyamine is shown. The resolution of hyperfine structure was precluded by ^{14}N interactions, though the magnitude of the α-proton hyperfine splittings and the very broad lines in the spectra from irradiated crystals grown from H_2O and D_2O indicated that there was significant unpaired electron density in the guanidino group. A table of α-proton hyperfine splittings and G-values for various related free radicals is shown. (auth) (Australia)

23621 RADICAL SCAVENGING IN γ-IRRADIATED POLY-4-METHYLPENT-1-ENE. Pinkerton, D. M. (Australian Defence Scientific Service, Alexandria, New South Wales); Whelan, D. J. Aust. J. Chem.; 24: 183-5(1971).

An ESR investigation of the radical species produced in γ-irradiated poly-4-methyl-1-pentene (at 77°K in vacuo) showed a radical that decayed rapidly and irreversibly on heating. At room temperature irradiation gave hydrogen, methane, propane, butane, and isobutane. The presence of O_2 introduced acetone as a major product. It is suggested that O_2 reacts with the radical formed at 77°K to form an unstable peroxy radical which then decomposes in a reaction analogous to the production of acetone from cumene. (Australia)

23622 TRIVALENT COPPER. I. A PULSE RADIOLYTIC STUDY OF THE CHEMICAL PROPERTIES OF THE AQUO COMPLEX. Meyerstein, D. (Nuclear Research Centre, Negev, Israel. Argonne National Lab., Ill.). Inorg. Chem.; 10: 638-41 (Mar 1971).

The mechanism of decomposition of the aquo trivalent copper ions in neutral and acid solutions was investigated. The effect of NO_2^-, Br^-, CH_3OH, and H_2O_2 on the disappearance of Cu(III)(aq) was studied. It is concluded that in neutral solutions the trivalent copper exists in the form of $CuOH^{2+}$(aq) or $Cu(OH)_2^+$(aq) and decomposes via $2CuOH^{2+} \rightarrow 2Cu^{2+} + H_2O_2$. In acid solutions the mechanism involves the formation of hydroxyl radicals probably via $Cu^{3+}(aq) \rightleftharpoons Cu^{2+} + OH$. The reaction $Cu^+ + CuOH^{2+}$(aq) is diffusion controlled. (auth)

23623 INVESTIGATIONS ON THE DEGRADATION OF POLYSULFONATED MACROMOLECULES BY MEANS OF RADIOACTIVE ISOTOPES. Furnica, Gh. (Institut d'Hygiene, Bucharest). Rev. Roum. Chim.; 15: 1591-9(Oct 1970). (In French).

The effects of ionizing radiation on the properties of synthetic macromolecular polyelectrolytes were studied by an investigation of the chemical transformation of certain functional groups. The ion exchange process dependent on structural transformations within sulfonated polyphenol macromolecules was studied by labeling the $-SO_3H$ group with ^{35}S and the mobile "counter ion" with ^{22}Na or ^{137}Cs and exposure to ionizing radiation emitted by ^{60}Co. Results confirmed the process of desulfonation of the polymers following the action of ionizing radiation. (J.G.B.)

23624 RADIOLYSIS OF ALCOHOLS: SOME MECHANISTIC CONSIDERATIONS. Basson, R. A. Nucl. Active; 27-30(Jan 1970). (In English and Afrikaans).

Currently accepted reaction mechanisms in the radiolysis of alcohols are reviewed. Evidence is presented for the fate of subexcitation electrons, for the chemical reactions of solvated electrons and the existence of ion fragmentation and ion–molecule reactions in condensed phases. (INIS)

23625 ELECTRON SPIN RESONANCE STUDY OF TRAPPED ELECTRONS IN γ-IRRADIATED HYDROCARBON POLYMERS. Keyser, Ronald Melvin. Knoxville, Tenn.; Univ. of Tennessee (1970). 181p. University Microfilms Order No. 71-353. Thesis.

Trapped electrons were detected by ESR spectroscopy in polyethylene, isotactic polypropylene, and poly(4-methyl-1-pentene) following γ irradiation at 77°K. In all cases, the ESR spectrum consists of a narrow singlet at $g = 2.0023 \pm 0.0002$ superimposed on a broad free radical spectrum. The singlet can be photobleached by near infrared light ($\lambda > 1000$ nm) and is readily saturated at low microwave powers. The singlet is assigned to a trapped electron since this behavior is analogous to that known to be characteristic of trapped electrons in γ-irradiated alkane glasses. Initial G-values for trapped electrons in these systems range from 0.46 for linear polyethylene down to 0.08 for isotactic poly(4-methyl-1-pentene). Both G-values and the maximum value attained in the concentration-dose curve for trapped electrons appear to be correlated with the crystallinity of the polymer and decrease with decreasing crystallinity. Little or no trapped electrons could be detected in noncrystalline polymers such as atactic polypropylene or polyisobutylene. These results strongly suggest that the electron trap is associated with crystalline regions of the polymer. The linewidth, ΔH_{ms}, of the trapped electron singlet is significantly less in these polymers in alkane glasses. The spin-lattice relaxation time of trapped electrons in polyethylene

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is an order of magnitude greater than for alkane glasses. Both the linewidths and relaxation times indicate that trapped electrons interact less strongly with their surroundings in semicrystalline polymers than in alkane glasses. In terms of a model in which vacancies or voids act as electron trapping sites, the decreased linewidth, longer spin-lattice relaxation time and red shift of the absorption spectrum in polymers relative to alkane glasses imply that the vacancy is significantly larger in polymers. The possibility that the electron is trapped in a row-vacancy defect associated with crystalline regions of the polymer is discussed and evidence derived from ESR studies of electron trapping in n-hexatriacontane is presented in support of this hypothesis. The thermal decay of trapped electrons in linear polyethylene has been investigated in detail over the temperature interval 77 to 127°K. The results suggest that there are populations of trapped electrons that are relatively stable toward thermal decay until the temperature is raised to a point where they become vulnerable. A correlation of trapped electron concentration with free radical concentration in γ-irradiated polyethylene has been observed. The trapped electron yield decreases with increasing free radical concentration, suggesting that free radicals may scavenge electrons. (Diss. Abstr. Int., B)

23626 ESR SPECTRUM OF BH_3^- IN GAMMA-IRRADIATED TETRAMETHYLAMMONIUM BOROHYDRIDE. Sprague, E. D.; Williams, F. (Univ. of Tennessee, Knoxville). Mol. Phys.; 20: 375-8(Feb 1971).

A study of the radiation damage caused by γ irradiation to dosages of ~1 Mrad of tetramethylammonium borohydride was made and a well resolved ESR spectrum attributable to BH_3^- obtained. Spectra obtained at 25°C, −100°C, and at −189°C are shown. These results differ significantly from values reported earlier (Catton et al. J. Chem. Soc. A. 2622 (1969)). Possible causes for these discrepancies are discussed. (UK)

23627 γ-RADIOLYSIS OF ALKANES. I. LIQUID n-PENTANE AND n-HEXANE. Pancini, Ettore; Santoro, Vittoria; Spadaccini, Giulio (Univ., Naples). Int. J. Radiat. Phys. Chem.; 2: 147-57 (Dec 1970).

The γ-radiolyses of liquid n-pentane and n-hexane were thoroughly investigated by means of gas-chromatographic analysis of all the products. The probability of fragmentation, dehydrogenation, and substitution at any given position of the molecule is given. The results obtained with the two hydrocarbons are compared and analogies in their behavior are revealed by taking account of the particular condition of the "central" position of pentane and assigning to it a statistical weight of half that of the other C atoms. Some special aspects of the experimental results, namely the identification of pentane dimers and the overall hydrogen balance, are discussed in detail. (auth) (UK)

23628 ESR STUDIES ON RADICAL PAIRS IN IRRADIATED POLYSTYRENE. Wilske, Juergen; Heusinger, H. (Technische Hochschule, Munich). Int. J. Radiat. Phys. Chem.; 2: 131-7 (Dec 1970).

In polystyrene (PS) radical pairs are formed during irradiation at 77°K by a reaction mechanism leading to simultaneous formation of two neighboring radicals. These radical pairs recombine at higher temperatures in a first-order reaction. The results confirm that cross links are formed in this reaction. (auth) (UK)

23629 INITIAL YIELD OF ETHYLENE FROM THE RADIOLYSIS OF METHANE. Hummel, R. W. (United Kingdom Atomic Energy Authority, Wantage, Eng.). Int. J. Radiat. Phys. Chem.; 2: 119-22(Dec 1970).

Rigorously purified CH_4 was irradiated with ^{60}Co γ rays and 7.5-MeV electrons to minimal absorbed doses (CH_4 conversions down to 2×10^{-5} percent) in order to determine the initial G value for C_2H_4 formation from CH_4 free of additives or scavengers. At a dose rate of 2.09×10^{15} eV g^{-1} s^{-1} it was found that $G_i(C_2H_4) = 1.4 \pm 0.3$. (auth) (UK)

23630 RADIOLYSIS OF ACETYLENE–NITROUS OXIDE MIXTURES AND THE EFFECT OF CARBON DIOXIDE. McLaren, K. G. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Int. J. Radiat. Phys. Chem.; 2 123-30 (Dec 1970).

Acetylene-nitrous oxide mixtures were irradiated to low dose levels ($\approx 4.1 \times 10^{19}$ eV g^{-1}) with ^{60}Co γ radiation. Nitrogen was formed, increasing with nitrous oxide concentration to a limiting value $G(N_2)_\infty = 18.2 \pm 1.7$ [equivalent to $4.7 \times G$(electron)], for mixtures containing around 20% N_2O. There was a small yield of carbon monoxide [$G(CO) = 0.32 \pm 0.08$], and the polyacetylene was oxygenated. Addition of sulphur hexafluoride prevented formation of nitrogen and when carbon dioxide was added to the acetylene-nitrous oxide system, nitrogen yields were reduced, tending to a lower limit around G(electron). The results can be explained on the basis of electron capture by nitrous oxide, followed by a short-chain process initiated by reaction of O^- ion with acetylene. Estimated relative rate constants for the proposed mechanism are given. Benzene was also formed, and the initial yield [$G(C_6H_6) = 11.1 \pm 1.2$] was not affected by electron scavenging, indicating that ion-neutralization reactions are not involved in the cyclization process. (auth) (UK)

23631 UNSTABLE INTERMEDIATES. PART LXXXIV. E.S.R. STUDY OF THE RADICAL XeF IN γ-IRRADIATED XeF_2. Eachus, R. S.; Symons, M. C. R. (Univ. of Leicester, Eng.). J. Chem. Soc., A; No. 2, 304-7(1971).

The magnetic parameters derived from the ESR spectrum of XeF in γ-irradiated XeF_2 at 77°K are comparable with those previously derived for this radical in XeF_4. Small differences can be adequately explained in terms of minor librations in XeF_4. The results are compared with those for V_K centers in alkali halides and environmental effects for these radical anions are discussed. Spin-densities calculated from the ^{19}F and ^{129}Xe atomic values suggest that the unpaired electron is in an orbital comprising 2s and 2p AOs on fluorine and 5s and 5p AOs on Xe. There is no need to invoke participation of the Xe 5d level, and any large admixture is improbable. (auth) (UK)

23632 INFLUENCE OF HYDROGEN BONDS ON THE STABILIZATION OF RADIATION-INDUCED RADICALS IN OXALIC ACID AND OXALATES. Damerau, W.; Lassmann, G. (Deutsche Akademie der Wissenschaften, Berlin). Stud. Biophys.; 13: 105-10(1969). (In German).

The radical yields (G_R-values) in x-irradiated oxalic acid dihydrate, anhydrous oxalic acid, and the normal and acid sodium salts of oxalic acid at room temperature are 0.045, 0.08, 0.16, and 0.19 respectively. G_R in the hydrogen-bonded oxalic acid is lower than in the nonhydrogen-bonded salts. From this and the comparison of the dose-yield curves and the radical decay in these compounds it is assumed that hydrogen bridges reduce the stabilization of radioinduced radicals only when the unpaired spin is localized in the neighborhood of the H-bridged proton. (auth)

Radioisotope Production

23633 ELAN-2B, INDUSTRIAL PILOT FOR MANUFACTURING ^{137}Cs AND ^{90}Sr SOURCES. Prevotel, Marc (CEA, Saclay, France). Ind. At.; 14: No. 9/10, 41-6(Sep-Oct 1970). (In French).

The first section of the pilot workshop ELAN-2B built at the Hague site started functioning in September 1970. It was designed principally to produce ^{137}Cs chloride from Cs extracted from the fission products of the reprocessing plants at Marcoule and the Hague. A mineral ion exchange extraction process was developed. The cell chain from which the sources are manufactured will use as raw material this Cs chloride or imported strontium titanate and is equipped with an installation for calcination under an active load. The construction of a second section is now envisaged; this will enable the Sr to be recovered. The combined development of Cs and Sr should considerably reduce the total cost of the curie by 1977 to 1980. (France)

23634 SEPARATION OF CARRIER-FREE ^{85}Sr FROM A DEUTERON-BOMBARDED RUBIDIUM TARGET. Inarida, Mariko; Shimamura, Akira (Inst. of Physical and Chemical Research, Tokyo). Radioisotopes (Tokyo); 20: 12-14(Jan 1971). (In Japanese).

Rubidium nitrate was bombarded by 15-MeV deuteron particles in the 160-cm IPCR cyclotron. The bombarded rubidium nitrate was dissolved in a hydrochloric acid solution of pH = 3, and 10% cupferron solution was added. The ^{85}Sr was extracted by shaking with TBP for 1 min. The extraction was repeated three times. The organic phase was washed with pH = 3 hydrochloric acid solution (2% cupferron) and then the carrier-free ^{85}Sr was back-extracted into pH = 3 hydrochloric acid solution. The recovery was about 95%. A carrier-free ^{85}Sr with sufficiently high radiochemical purity was obtained by this simple procedure. (auth)

23635 FORMATION AND PROPERTIES OF TRANSURANIUM ELEMENTS. Lindner, R. (Europaeisches Institut fuer Transurane, Karlsruhe, Ger.). Atomwirt., Atomtech.; 16: 47-50(Jan 1971). (In German).

Formation and characteristics of other transuranium elements are being studied. The difficulties of formation and detection, which increase with atomic number, detection methods, nuclear structure, and decay scheme, are discussed. The existence of stability islands, the first of which occupies atomic numbers ranging from 110 through 114, is also considered. Elements on

this island possess interesting nuclear properties such as release of ten to eleven neutrons per fission. (tr-auth)

Recoil Production and Reactions

Refer also to abstracts 25204 and 25264.

23636 pH DEPENDENCE OF THE RECOIL BEHAVIOR OF ^{198}Au ATOMS IN AURIC CHLORIDE SOLUTION. Suh, In Suck; Lee, Choo Kyung (Atomic Energy Research Inst., Seoul). J. Nucl. Sci. (Seoul); 10: No. 2, Part 1, 7-10(1970).

The Szilard–Chalmers process was applied to solutions of auric chloride (1 mg Au/ml) at varying pH. The solutions were irradiated by the TRIGA Mark-II reactor, and the resulting recoil species were separated by a paper chromatographic method. Gold content in the separated fractions was determined by activation analysis. Enrichment was highest between a pH of 8.5 and 10. (J.G.B.)

23637 COMPONENTS OF RETENTION IN THE PULVERIZED SOLID RECOIL SYSTEM. Ikeda, Nagao; Kujirai, Osamu (Tokyo Kyoiku Univ.). Radioisotopes (Tokyo): 20: 36-7(Jan 1971).

The components of retention were studied for pulverized mixtures of K_2CrO_4 and $[Co(NH_3)_6]Cl_3$ irradiated with neutrons. Chemical treatment of each sample was carried out for determination of the central atom substitution yield (radiochemical yield of ^{51}Cr found in the $[Cr^*(NH_3)_6]^{3+}$ fraction) and the retention of ^{51}Cr. The values are shown graphically, and indicate that the central atom substitution yield increases proportionally with respect to $[Co(NH_3)_6]Cl_3$ mole fraction ([Co]) while the retention decreases linearly with increasing mole fraction. The concept is presented that the retention is composed of two components, "home retention," retention that is concerned only in the particle in which the recoil atom was produced, and "visiting retention," retention that is based on the lattice exchange, recombination, or oxidation of recoil atoms in other particles than that in which the recoil was produced. On the basis of this concept, the total retention values of the single component system K_2CrO_4 are discussed. (B.L.M.)

23638 STUDY OF THE SZILARD–CHALMERS REACTION OF ETHYL IODIDE AT LOW THERMAL NEUTRON FLUXES. Brown, B. J.; Carswell, D. J. (Univ. of New South Wales, Kensington, Australia). Aust. J. Chem.; 24: 25-30(1971).

It is shown that the simple interpretation of the Szilard–Chalmers reaction in ethyl iodide, viz., bond rupture of the radiohalide and absence of subsequent chemical exchange, is not entirely valid. The results also verify and explain the apparently anomalous radiohalide yield of zero for neutron irradiation of pure ethyl iodide in the absence of a γ flux. At low neutron fluxes free radiohalide yields in the liquid phase were shown to be a function of irradiation and post-irradiation time, γ pre-irradiation dose, and fast/thermal neutron ratio. These results are consistent with the hypothesis that exchange occurs at a rate that decreases as the free iodine concentration increases. Neutron irradiation of ethyl iodide at 77°K produces radioactive iodine in a metastable free state, which does not undergo recombination in the frozen solid phase. The rate of post-irradiation recombination between free iodine-128 and the thawed liquid organic phase is independent of irradiation time and was found to be significantly faster than the rate corresponding to neutron irradiation at room temperature. (auth) (Australia)

Radiochemistry

Refer also to abstracts 23541, 24246, and 24247.

23639 STABILITY OF RADIOACTIVE CHEMICALS AND DRUGS. Catch, John R. (Radiochemical Centre, Amersham, Eng.). pp 19-42 of International Conference on Radioactive Isotopes in Pharmacology, Geneva, 20-23 September 1967. /Waser, P. G. (ed.). New York; John Wiley and Sons Ltd. (1969).

From International Conference on Radioactive Isotopes in Pharmacology, Geneva, Switzerland. See CONF-670998.

Features of purity and analysis fundamental to a discussion of the stability of labeled compounds are considered. The distinction between chemical and radiochemical purity is discussed. The ways in which chemical decomposition can be reduced are considered. The mechanisms of radiolysis of complex organic compounds are discussed, including: primary internal effects, primary external effects, and secondary effects such as use of diluent, use of a scavenger, and temperature. The precautions that may be advisable in handling or storing the compounds are summarized. (M.C.G.)

Separation Processes

Refer also to abstracts 23542, 23544, and 23587.

23640 (AAEC/LIB/Bib-273) BIBLIOGRAPHY ON ISOTOPE SEPARATION BY ION EXCHANGE. Garman, D. E. J.; Beach, P. M.; Fardy, J. J. (comps.); Newland, E. A.; Williamson, P. K. (eds.) (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov 1970. 33p. Dep. NTIS (U. S. Sales Only).

One hundred ninety-two references are listed, covering the period 1938 to 1970, and arranged alphabetically by author within a chronological listing by year. References are given to an abstract for each article. (Australia)

23641 (ANL-7767) CHEMICAL ENGINEERING DIVISION FUEL CYCLE TECHNOLOGY QUARTERLY REPORT, OCTOBER-DECEMBER 1970. Webster, D. S.; Jonke, A. A.; Bernstein, G. J.; Levitz, N. M.; Pierce, R. D.; Steindler, M. J.; Vogel, R. C. (Argonne National Lab., Ill.). Jan 1971. Contract W-31-109-eng-38. 33p. Dep. NTIS.

Work was done in the following areas: (1) further development of a head-end process for removing stainless steel cladding in a zinc bath by study of decladding rates, fission gas behavior, and reduction of declad fuel oxide; (2) investigation of a procedure for separating stainless steel cladding from fuel oxide by melting the cladding; (3) further laboratory-scale work to develop a fluid-bed process for the conversion of uranyl nitrate and plutonium nitrate in nitric acid solutions to an oxide form (UO_2–PuO_2) suitable for the fabrication of fuel shapes for LMFBR fuel; (4) additional development of x-ray fluorescence spectrometry as an in-line analytical method for determining the Pu/U ratio of oxide fuels during fabrication; and (5) continued investigation of the performance characteristics of a centrifugal contactor for the plutonium isolation steps in the solvent extraction of LMFBR fuels. (auth)

23642 (ANL-7772) THE EBR-II SKULL RECLAMATION PROCESS. PART V. DESIGN AND DEVELOPMENT OF PLANT-SCALE EQUIPMENT. Bernstein, G. J.; Grosvenor, D. E.; Lenc, J. F.; Miller, W. E.; Winsch, I. O.; Wolkoff, J.; Paul, R. C. (Argonne National Lab., Ill.). Jan 1971. Contract W-31-109-eng-38. 27p. Dep. NTIS.

A plant-scale skull-oxide reduction and purification furnace and associated components were designed, installed in an argon-atmosphere enclosure, and evaluated during the performance of 18 skull-reclamation runs. This equipment was used to perform the noble-metal extraction step, oxide-reduction step, and product-dissolution step of the skull-reclamation process. Among the components whose designs and design modifications are presented in some detail are the furnace itself, tungsten crucible, agitator shaft bearing and seal assembly, charging hopper, transfer receiver (waste receiver), and transfer line. Equipment was modified in accordance with flowsheet changes and experience gained in pilot-scale runs and initial plant-scale runs. The overall performance of the equipment demonstrated that plant-scale skull-reclamation runs are feasible and can be adapted to remote operation. (auth)

23643 (BARC-518) SYNTHESES OF PHYLLITIC MINERALS: THEIR UTILISATION IN RADIOACTIVE WASTE TREATMENT. PART III. FROM MIXED GELS OF SILICA AND ALUMINA IN PRESENCE OF LITHIUM SULPHATE. Brat, Satya; Balu, K. (Bhabha Atomic Research Centre, Bombay (India)). 1971. 16p. Dep. NTIS (U. S. Sales Only).

Syntheses of phyllitic silicate minerals were carried out using mixed gels of silica and alumina, in the presence of lithium sulfate at atmospheric pressure and at approximately 100°C. The products were evaluated by x-ray analyses and found to be crystalline and belong to the "hectorite" family (montmorillonite, with interlayer ion as Li^+). The suitability of the synthetic products for decontamination of radioactive wastes with CsCl + ^{134}Cs was studied and the products were promising for the removal of radioactive cesium from liquid wastes. (auth)

23644 (BNL-50254) LOW-TEMPERATURE ADSORPTION OF KRYPTON ON SOLID ADSORBENTS. Wirsing, E. Jr.; Hatch, L. P.; Dodge, B. F. (Brookhaven National Lab., Upton, N. Y.). Jun 1970. 13p. Dep. NTIS.

Krypton was adsorbed on solid adsorbents from dilute mixtures with nitrogen and air, at temperatures ranging from –150°F (–101°C) to –300°F(–184°C). Adsorbents used were cocoanut charcoal, molecular sieves 5A and 13X, and silica gel. Adsorption was from streams of gas flowing through packed beds, with mass flow rates ranging from 56 to 3080 lb/hr · ft^2. Total pressure was

generally 1 atmosphere. Krypton concentrations in the feed ranged from 1 to 4000 ppM by volume. Adsorbent capacities for krypton and krypton enrichment factors were determined for various conditions of operation. (auth)

23645 (DOCKET-50201-66) WEST VALLEY REPROCESSING PLANT. Low Level Liquid Waste Treatment Plant. Final Safety Analysis Report, Suppl. 1. (Nuclear Fuel Services, Inc., Rockville, Md.). Mar 1971. 10p. Dep. NTIS.

Answers to 11 questions on the low-level waste treatment plant are given. These cover the following subjects: plant feed composition, lagoon effluent, laundry waste discharges, stack disposal, ruthenium levels in liquid effluent, radiation monitoring, shielding calculations, filters, ion-exchange unit, equipment failure, and tornado effects on off-site release. (M.C.G.)

23646 (RT/CHI-(70)15) SOLVENT EXTRACTION WITH HYDROXAMIC ACIDS. I. Grossi, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1970. 59p. Dep. NTIS (U. S. Sales Only).

Hydroxamic acids are being considered as a possible new category of selective extractants. Some results related to studies on the chemical and radiolytic damage to diluents employed in the aqueous reprocessing of irradiated nuclear fuels drew attention to the complexing capacity of the hydroxamic function. Since this function can easily form stable complexes with a great number of metal ions, it was supposed that an organic soluble hydroxamic acid could be a powerful selective extractant. As a check of such an hypothesis, an analysis of literature data on the utilization of hydroxamic acids in the solvent extraction chemistry and, more generally, in analytical chemistry was carried out. After a careful examination of this review, the principal features that a hypothetical hydroxamic acid could have in order to be conveniently employed as extracting agent were pointed out. In order to clarify the structure and the main physical and chemical properties of hydroxamic acids, an appendix is included in which the principal literature data on the chemistry of hydroxamic acids are summarized. The most usual procedures of preparation and of characterization of hydroxamic acids are described in detail. (auth)

23647 (RT/CHI-(70)19) SOLVENT EXTRACTION WITH HYDROXAMIC ACIDS. II. 3, 4, 5 TRIETHOXYBENZOHYDROXAMIC ACID: SYNTHESIS AND CHARACTERIZATION. Grossi, G.; Biondi, G. B. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1970. 22p. Dep. NTIS (U. S. Sales Only).

The preparation of 3,4,5-triethoxybenzohydroxamic acid is described. The values of neutralization equivalent, ionization constant, solubility in water and in several organic diluents, and distribution coefficient between some organic solvents and water solutions were obtained. The chemical stability of this acid in contact with aqueous acidic solutions was tested. Starting from the results obtained, the possibility of application of such a hydroxamic acid to solvent extraction is discussed. (auth)

23648 (RT/CHI-(70)20) UNIRRADIATED THORIUM-URANIUM OXIDE FUEL ELEMENTS DISSOLUTION IN RECIRCULATOR DISSOLVERS IN BENCH SCALE AND PILOT PLANT OPERATIONS. Beone, G.; Caropreso, G.; Ferri, F.; Galuppi, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 26 May 1970. 109p. (In Italian). Dep. NTIS (U. S. Sales Only).

Studies were made to determine the dissolution rate and the kinetic reaction of ThO_2-UO_2 fuel element core material, similar to that to be used by the Elk River reactor, in nitric acid-fluoride solutions. Moreover, it was necessary to investigate the following factors: hydrodynamic and thermodynamic conditions during dissolution, characteristics of measuring and control circuits, necessary time for individual operations, and determination of fuel losses. (auth)

23649 (RT/CHI-(70)26) SOLVENT EXTRACTION WITH HYDROXAMIC ACIDS. IV. THE SOLVENT EXTRACTION OF URANIUM (VI) WITH NEO-TRIDECANO-HYDROXAMIC ACID. Baroncelli, F.; Grossi, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1970. 36p. Dep. NTIS (U. S. Sales Only).

Solvent extraction of uranyl ions by means of neotridecanohydroxamic acid was studied, taking into account the influence of the equilibrium pH of the aqueous phase, the nature of the diluent used, total uranyl ion concentration, and total hydroxamic acid concentration. In order to easily control the extraction pH without introducing undesired substances in the aqueous phase, a mixed solution of the hydroxamic acid with long-chain aliphatic amines was investigated. The results obtained show that neotridecanohydroxamic acid may be conveniently employed as novel extracting agent of uranyl ions. (auth)

23650 (RT/CHI-(70)27) SOLVENT EXTRACTION WITH HYDROXAMIC ACIDS. III. BRANCHED-CHAIN ALIPHATIC HYDROXAMIC ACIDS. THE MONOHYDROXAMIC DERIVATIVE OF NEO-TRIDECANOIC ACID. Grossi, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1970. 59p. Dep. NTIS (U. S. Sales Only).

The chemistry of carboxylic acids whose carboxyl group is bound to a tertiary carbon atom (the so-called neo acids) is reviewed and the synthesis of the monohydroxamic derivative of neotridecanoic acid is described. The neutralization equivalent, ionization constant, infrared and ultraviolet spectra, solubility in aqueous and organic phases, distribution coefficients, and thermal and chemical stability of this compound were obtained. The results indicate that the neotridecanohydroxamic acid can be conveniently employed as an extracting agent for analytical as well as for industrial recovery purposes. (auth)

23651 (STI/PUB-262) RECOVERY OF URANIUM. Proceedings Series. Proceedings of a Symposium Held in Sao Paulo, 17-21 August 1970. (International Atomic Energy Agency, Vienna (Austria)). Feb 1971. 489p. (In several languages). (CONF-700836). IAEA $13.00.

Thirty-five papers on uranium production are presented. An abstract was prepared for each paper. (M.C.G.)

For abstracts of individual papers see: 23554, 23555, and 23658-23690.

23652 (UCRL-51003) ISOTOPIC ENRICHMENT BY ELECTROMIGRATION IN AQUEOUS SOLUTIONS. Ryon, R. W.; Miller, D. G. (California Univ., Livermore. Lawrence Radiation Lab.). 10 Feb 1971. 25p. Dep. NTIS.

Isotope separations were produced by electromigration in concentrated aqueous solutions of transition-metal halides in which a significant chemical exchange contribution to the overall separation process is expected. $CuBr_2$, $FeCl_3$, $NiCl_2$, and $NiBr_2$ were investigated. The heavy isotopes of copper and iron were enriched toward the cathode, whereas nickel showed the familiar heavy-isotope enrichment toward the anode. "Process constants" ($\epsilon\mu/D$) as high as 1.9×10^{-3} V^{-1} have been obtained for $CuBr_2$. Chemical exchange between isotope species (i.e., $^{63}CuBr^+ + {}^{65}CuBr_2^0 \rightleftharpoons {}^{65}CuBr^+ + {}^{63}CuBr_2^0$) is demonstrated by the size of the process constants and by the reversal of the usual enrichment direction. This exchange was exploited in aqueous electromigration separations. The $CuBr_2$ process constant is about ten times greater than those obtained by previous workers; suggestions for further experimental improvements are made. It was concluded that this method is not likely to be useful for efficient large-scale separations, especially for heavy isotopes. (auth)

23653 (UJV-2345.Ch.) DEVELOPMENT OF SELECTIVE SORBENTS AND OF AN OPTIMUM CONTACTOR FOR WASTE WATER DECONTAMINATION. II. DESIGN OF A CLARIFIER-CONTACTOR FOR SLUDGE SEPARATION. Napravnik, J.; Verner, M. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). [nd]. 189p. (In Czech). NTIS (U. S. Sales Only).

A circular clarifier-contactor of a total height of 1600 mm and a diameter of 450 mm was designed based on experimental values for the sedimentation rates of suspensions of $Cu_2[Fe(CN)_6]$, $BaSO_4 + CaSO_4$, and their mixture with activated charcoal. The volume of the inner working space is approximately 0.1 m^3, and its diameter and height are 350 and 1100 mm, respectively. Decontamination factors of about 99.8% were attained in tests with model solutions containing $^{137}Cs + {}^{137}Ba$, $^{90}Sr + {}^{90}Y$, their mixture, and ^{131}I; merely for the case of iodine sorption on activated charcoal the decontamination factor was 50% but it could be improved by a prolongation of the contact period. The operation of the clarifier-contactor was trouble-free. The volume contraction of the treated solution was 99.1 to 99.6%. (INIS)

23654 (UJV-2360.Ch.) RADIOIODINE REMOVAL FROM WASTE WATER AFTER A REACTOR ACCIDENT. Pribyl, J.; Napravnik, J. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). [nd]. 11p. (In Czech). NTIS (U. S. Sales Only).

To find a suitable technology for decontamination of waste water containing radioiodine, the sorption of iodine from model waste solutions by anion exchangers Wofatit SBW and Anionit EDE-10-P was studied. In a stationary arrangement the sorption efficiency exceeded 90%. The adsorption of radioiodine on various types of activated carbon was unsatisfactory. On a pilot-plant scale the sorption of radioiodine was studied on a column filled with Wofatit SBW. The operation of the ion-exchange column was trouble-free, and the average separation efficiency was 98.0 to 99.3%. (INIS)

23655 CONCENTRATION OF Cr, Mn, Fe, Zn, AND Ru TRACES BY ALUMINUM AND STRONTIUM PHOSPHATES.

Bacic, I. (Univ. of Zagreb); Radakovic, N.; Strohal, P. Anal. Chim. Acta; 54: 149-51(Mar 1971).

The concentration of trace elements by phosphate coprecipitation was studied. Strontium and aluminum phosphates were chosen for these investigations, because they are known to be present in certain biological and geological systems that have explicit sorption properties. The effects of surface-active agents and the pH of the medium on coprecipitation yields were investigated. With the exception of ruthenium, quantitative coprecipitation of the microconstituents was achieved in a wide range of pH values. (J.G.B.)

23656 PROCESSING OF URANIUM ORES. Geier, H. (Lurgi-Gesellschaft fuer Chemotechnik mbH., Frankfurt am Main). Metallges., Mitt. Arbeitsbereich; No. 13, 29-36(1970). (In German).

The processing of uranium ores is described. The acid and alkaline treatment method is described in detail. Future developments of the industrial processing engineering are mentioned. Investment cost for processing plants, production costs, and the uranium market are discussed. (INIS)

23657 NEW VARIATION IN LANTHANIDE–ACTINIDE SEPARATION. Ali, S. A.; Eberle, S. H. (Kernforschungszentrum, Karlsruhe, Ger.). Inorg. Nucl. Chem. Lett.; 7: 153-9(Feb 1971). (In German).

The method combines extraction chromatography with filtration. Bis(2-ethylhexyl)phosphate is carried on glass beads; the aqueous phase is lactic acid and [(Carboxymethylimino)bis(ethylenenitrilo)] tetraacetic acid in dilute nitric acid. Tests with americium vs. cerium, europium, terbium, and curium showed that lanthanides are separated from actinides, with a separation factor of at least 5. Optimum conditions are stated, together with two procedures for recovering actinides from the filtrate. The method is quick (about 2 hours) and avoids radiation damage to the chromatographic column. (UK)

23658 SOME RECENT DEVELOPMENTS IN URANIUM ORE PROCESSING RESEARCH IN THE UNITED KINGDOM. Smith, S. E.; White, P. A. (Atomic Weapons Research Establishment, Aldermaston, Eng.). pp 3-16 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

A world wide survey was carried out of the present state of the technology of processing uranium ores. This sought to identify what research work had already been done and what was being done currently and, in particular, what scope there was for work in the United Kingdom that was not being carried out elsewhere. The main concern was to improve the extraction of presently and marginally economic ores, but areas of research that also would be relevant to very-low-grade ores were studied. The emphasis was placed on those parts of the extraction process where costs are highest, i.e., preconcentration and leaching rather than the later purification stages. As a result of this survey a new program of research was instituted and has now been running for approximately one and a half years; this is being carried out at a number of centers and the main topics of investigation are: upgrading, particularly lump ore sorting; new economically attractive methods of chemical leaching; bacterially assisted leaching; and in-pulp purification by continuous ion exchange. Bacterial leaching work was continued and augmented by a new fundamental program at the Microbiological Research Establishment to elucidate the basic microbiology. This is regarded as primarily long-term research. Results are given on the progress made on the development of a lump ore sorter, based on a new detection principle, for sorting small lumps at very high rates, and on leaching by strong acid curing followed by percolation, which was tried with success on a number of important ores. Both of these developments appear to have the potential of applications on a relatively short time scale, with economic advantages. In conclusion, a brief look at the modifications in general flowsheeting that might arise from such improvements is made. (auth)

23659 NEW PROSPECTS IN THE TREATMENT OF URANIUM ORES AND THE PREPARATION OF CONCENTRATES FOR DIRECT USE. Gautier, R. (Ugine Kuhlmann, La Madeleine, France). pp 17-32 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971). (In French).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

As a result of studies relating to the improvement of existing concentration plants, research into processes for application to known ores and more recently discovered deposits (in cases where type and geographical situation pose particular problems) and research into methods of obtaining high-purity UF_6 concentrates, the Ugine Kuhlmann Company set about developing and applying processes capable of meeting the latest requirements. These processes are described, with particular reference to: (1) A process that forms the design basis for a plant currently under construction in the Republic of the Niger; (2) A process currently undergoing pilot-plant testing before the construction of a concentration plant in the Central African Republic; (3) The process studied and developed for the Société de fluoration de l'uranium, and employed at the Eurochemic plant at Mol, Belgium, for the direct conversion of uranyl nitrate to uranium tetrafluoride. (auth)

23660 REVIEW OF THE APPLICATION OF BENEFICIATION PROCESSES TO URANIUM ORES BEFORE LEACHING. Tutt, D. J. (Anglo American Corp. of South Africa Ltd., Johannesburg). pp 33-41 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

Present known ore beneficiation processes are reviewed. Ore beneficiation processes and equipment trends discussed are based on sizing, sorting, gravity separation, and froth flotation procedures. The economic influences that a uranium upgrading process has on subsequent mineral extraction operations are discussed. (auth)

23661 DEVELOPMENT IN THE TREATMENT OF URANIUM ORES FROM THE GORENJA VAS AREA. Zivanovic, Vera; Vracar, N.; Milic, D.; (and others) (Inst. for Tech. of Nuclear and Other Mineral Raw Materials, Belgrade). pp 43-56 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

Uranium processing research in this district of Yugoslavia includes radiometric sorting, autogenous milling, leaching, solid-liquid separation, ion exchange, and solvent extraction. This ore proved favorable for radiometric sorting, giving a successful elimination of about 30% of the low-grade ore arriving at the input. Ore processing includes autogenous milling as the grinding method. The experiments were carried out in an autogenous mill in closed circuit with a spiral classifier. Autogenous milling was shown to be economic as a standard routine with advantages for the acid uranium-leaching process over other routines. The ground ore obtained has small admixtures of metallic iron of uniform granular structure. Since it was impossible to choose alkali or acid leaching from the mineralogic and chemical characteristics of the ore the experiments were performed using both sodium carbonate and sulfuric acid processing. The latter gave better results. Various ore samples from the Žirovski Vrh deposit showed a variety of characteristics. The data on solid-liquid separation are given with respect to filtration or counter-current decantation processes. Further research is being carried out on ion-exchange and solvent-extraction recovery of uranium from clear solutions. (auth)

23662 LEACHING EXPERIMENTS OF URANIFEROUS SHALES AND SANDSTONES FROM QATRANI, WESTERN DESERT, UNITED ARAB REPUBLIC. El Shazly, E. M.; El Hazek, N. M. T.; Zayed, Z. M. (Atomic Energy Establishment, Cairo). pp 57-66 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

The uraniferous shales of Qatrani are characterized by their complex mineralogical composition of clays mainly represented by montmorillonite, with variable concentrations of calcite and dolomite, gypsum, haematite and goethite, humic organic matter, free quartz sand, native sulfur, some felspars altered to sericite, etc. Physical methods of concentration including sieving, magnetic separation, heavy-liquid separation, tabling and flotation failed to make fractions with a higher uranium than the original shale used in the experiments, which contained 240 ppM U. Direct alkaline leaching is not promising because of the high consumption of sodium carbonate due to the presence of gypsum and organic matter; also uranium extraction is not possible in this medium. Recovery of uranium could be effected through methanol precipitation of uranium and sodium sulfate. Redissolving in a minimum of water, followed by sodic decomposition with soda. Direct acid leaching was not promising because of the high acid consumption caused by the abundance of carbonates and the presence of organic matter. The acid process was improved by roasting followed by slaking and then leaching with sulfuric acid and ultimately recovering uranium by an anion-exchange resin IRA 400. The red ferruginous sandstone of Qatrani is constituted of quartz sand with haematite and goethite associated with a little carbonate, namely dolomite. Experiments carried out on sandstone containing 260 ppM U indicated that uranium leaching is mainly connected with the dissolution of the iron oxides. Hydrochloric acid was found

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to be the best acid for leaching, while the addition of an oxidant, namely MnO_2, was necessary for the process. (auth)

23663 PROCESSING OF A MOLYBDENUM–URANIUM ORE FROM THE POCOS DE CALDAS PLATEAU. Calmon Costa, E.; Batista, H. F.; Castro, L. O.; De Oliveira, A. G. (Comissao Nacional de Energia Nuclear, Rio de Janeiro). pp 67-78 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

The unusual behavior under processing of samples from hydrothermal deposits in the Poços de Caldas plateau is described. The ore assays on the average 0.22% U_3O_8, 0.85% MoO_3, 0.10% ThO_2, 0.035% V_2O_5, and 2.5% ZnO_2. Conventional acid leaching of samples from depths above approximately 20 m yields uranium recoveries in excess of 90%, after removal of over 90% of the molybdenum by leaching with dilute alkaline solutions. Alkaline leaching of the uranium with carbonate–bicarbonate solutions yields low recoveries. Samples from depths below 20 m are very refractory to acid leaching, yielding only about 3% recoveries in a one-stage contactor, whereas molybdenum recoveries are generally high. Part of the insoluble uranium is known to be associated with the highly refractory zircon. Uranium recoveries as high as 93% can be attained by hot-curing the residue with concentrated sulfuric acid, after extraction of the soluble molybdenum and uranium. In this case, acid consumption is high, amounting to 650 kg/ton ore. However, marketing the molybdenum concentrate makes the process economically feasible. Leach liquors are processed by solvent extraction with a tertiary amine. (auth)

23664 URANIUM LEACHING AND RECOVERY FROM THE PRIMARY ORE OF EL ATSHAN, EASTERN DESERT, UNITED ARAB REPUBLIC. El Shazly, E. M.; El Hazek, N. M. T. (Atomic Energy Establishment, Cairo). pp 79-87 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971).

The primary ore of El Atshan is constituted of coffinite, pitchblende, and a graphitic Nb–Ti–Zr–U refractory mineral, with the sulfides sphalerite, galena, pyrite, and chalcopyrite, in a gangue of silicate minerals mainly represented by felspars, altered ferromagnesians, and clays with some carbonates including calcite, dolomite, and ankerite, in addition to some quartz, fluorite, and iron oxides. The ore is characterized by the locking of uranium in nonrefractory and refractory minerals and by the presence of both sulfides and carbonates. Considerable experimental work was carried out on crushing, grinding, and leaching of the ore. Orientating leaching experiments were conducted using acid leaching, atmospheric alkaline leaching, pressure alkaline leaching, roasting, and chloride roasting followed by acid and alkaline leaching or acid leaching only. Physical dressing of the ore was tried, and it was possible to separate a fraction with sulfides and a fraction with carbonates by flotation using sodium xanthate. Following the above experiments a scheme of uranium recovery was elaborated based on sulfide flotation followed by acid leaching under relatively severe conditions for the floated small sulfide-rich fraction having also a high uranium content and the alkaline leaching of the nonfloated main fraction containing carbonates. Uranium was recovered from the acid-pregnant liquor by an organic solvent. Adogen 368 tertiary amine diluted in kerosene, and the carbonate-pregnant liquor is then used to strip back the uranium from the solvent. Uranium is precipitated from the carbonate liquor as sodium diuranate, containing no particularly harmful impurities through sodic decomposition by sodium hydroxide. (auth)

23665 URANIUM PROCESSING RESEARCH OF THE ZLETOVSKA REKA DISTRICT. Zivanovic, Vera (Inst. for Tech. of Nuclear and Other Mineral Raw Materials, Belgrade). pp 89-96 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

Ore bodies of remarkable size and having a favorable uranium grade are found in the Zletovo–Kratovo area. Since the reserves of U_3O_8 determined to date have not yet been increased, a fast capillary leaching method using an aqueous sulfuric acid solution was developed for this ore. Kinetics are given for uranium leaching, which prove that they depend mainly on the initial acid concentration in the leaching solution, as a function of flow rate. Leaching parameters are defined as: sprinkling and draining time intervals, the ore granularity, volume of solution for sprinkling and its flow rate, and grain size of the ore. The average recovery of uranium is about 80% over a three-day leaching period. Uranium extraction from the leach solution is done by ion exchange and solvent extraction. The ore processing technology was adopted on the basis of larger-scale investigations treating 1 and 5 ton samples. The economics of the processing are more attractive than those of standard treatment methods. Savings in capital investment are important, being over 25%. (auth)

23666 URANIUM PROCESSING PILOT MILL AT THE NINGYO-TOGE MINE. Takada, S.; Amanuma, T.; Fukuda, G. (Power Reactor and Nuclear Fuel Development Corp., Kamisaihara, Japan). pp 97-110 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

In 1964, a pilot plant for treating domestic uranium ores (0.03 to 0.15% U_3O_8) was constructed at the Ningyo-toge mine in Japan. This pilot plant has operated smoothly to date, with several successful improvements and modifications. The operation results of this pilot plant are summarized as follows: (1) In the case of treating low-grade (about 0.05% U_3O_8) and unoxidized ore, washing, screening, and sand-slime separation are useful as means of preconcentration by discarding barren gravels and grains, and a reduction of more than 50% in direct operating cost was thus obtained compared with that of operations without preconcentration; (2) In the case of treating some clay-rich ore, a strong acid pugging and heating process is suitable for obtaining a higher (4 to 15%) uranium recovery compared with that of conventional acid leach process, but the problem for a future study is how to reduce acid consumption as, to date, this acid consumption is similar to that of conventional leaching; (3) In the case of treating a poor (0.08 to 0.3 g U/liter) pregnant solution, it was recognized that it is more economical to adopt the ion-exchange process between the liquid-solids separation process and the Amex Chloride Conversion Process, in order to obtain a more concentrated pregnant solution and subsequently to reduce solvent loss from the Amex Chloride Conversion Process; (4) The Amex Chloride Conversion Process was adopted for recovering uranium from the pregnant solution, by which process a concentrated uranyl chloride solution (over 100 g U/liter) of high purity was obtained from a sulfate pregnant solution. The uranyl chloride solution was sent to the Tokai Pilot Refinery and converted in a wet process into uranium tetrafluoride by electrolytic reduction and hydrofluorination. The results of chemical analyses of the pregnant solution, uranyl chloride solution, and uranium tetrafluoride show that when combined with the reduction of the uranyl ion and a hydrofluorination process, the Amex Chloride Conversion Process is applicable to the production of the reactorgrade uranium tetrafluoride directly from ore without passing through the stage of yellow cake production. (auth)

23667 URANIUM RECOVERY FROM LEACH LIQUORS IN THE SENHOR DAS FONTES TREATMENT PLANT. Tomas, A. (Commission de l'Energie Nucleaire, Lisbon). pp 111-22 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971). (In French).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

A significant part of the Portuguese uranium reserves are of the schistous ore type. Thus, it was decided to submit these products to uranium solubilization and extraction tests in a chemical treatment pilot plant. The processes being developed is described, along with the main results so far achieved in the following fields: (1) Static leaching of the coarse fraction (size 1 to 16 mm), after grinding and wet classification of the ore. (2) Conventional acid-leaching of the sanded slimes (solid fraction sizing 0 to 1 mm). (3) Ion-exchange extraction of uranium from the leach liquors. (4) Solvent extraction of uranium from the leach liquors. (5) Ion-exchange extraction of uranium from leach liquors combined with solvent extraction of the eluate solutions from that circuit. The daily feed of the pilot plant is 40 t and the ore grade averages 0.14% U_3O_8. In the static leaching, the uranium recovery is 84.21% and in the conventional leaching 86.77%; the corresponding sulfuric acid consumptions are 31.9 kg/t and 50.0 kg/t. The overall recovery is about 85%. The uranium concentrates obtained by ion exchange were rather impure (70.7% U_3O_8), while those from solvent extraction were of much better quality (85.4% U_3O_8). (auth)

23668 MODERNIZATION OF THE CHEMICAL PROCESSING PLANT FOR URANIUM ORES AT URGEIRICA. Pich, H. C.; Santos, C. S.; Elias, J. T.; (and others) (Commission de l'Energie Nucleaire, Sacavem, Portugal). pp 123-45 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971). (In French).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

The chemical processing plants for uranium ores at Urgeiriça were improved. These plants were producing a concentrate with about 15% U_3O_8 by direct precipitation of uranium (using magnesium) from sulfuric leaching liquors. The aim was to produce a

concentrate with a high uranium content in accordance with international standards, and to make use as far as possible of existing equipment. The reasons for adoption of the solvent extraction process are explained. These are based essentially on a technico-economic study in which other possibilities were investigated. A brief description is given of the characteristics of the Urgeiriça ore, which served as a model for the studies and calculations. The main conclusions drawn from laboratory experiments undertaken either to supply missing information or to confirm existing information are also presented. Some of the parameters relating to leaching, solid-liquid separation, and precipitation were studied. Particular attention was given to solvent extraction with a view to industrial application. (auth)

23669 UTAH CONSTRUCTION AND MINING COMPANY'S UNIQUE SHIRLEY BASIN URANIUM MILL. Ritchie, M. I. (Utah Construction and Mining Co., San Francisco). pp 147-56 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

Design is complete and construction in progress on a 1200-ton per day milling facility capable of producing 2.5 million pounds U_3O_8 annually. Eliminating conventional crushing and fine ore storage, run of mine ore is fed directly to a semi-autogenous cascade mill to be ground in water and classified employing screens situated in closed circuit with the mill. Minus 20 mesh material in a 60% solids pulp is stored in air-agitated tanks prior to continuous pachuca two-stage leaching, using sulfuric acid as the solvent and oxidation levels controlled by sodium chlorate addition. Liquid–solid separation is to be achieved in washing thickeners with flows controlled by variable speed pumps and flowmeters only. The pregnant solution produced will be clarified in specially designed activated carbon clarifiers prior to presentation to a fixed bed multi-column ion-exchange circuit using a macroreticular weak base resin as the uranium adsorption medium. Uranium elution will be achieved using a solution mixture of sodium chloride and ammonium sulfate. The purified and concentrated uranium bearing liquor will be carefully neutralized in a split precipitation circuit in order to ultimately produce a virtually sodium-free product, meeting the stringent yellow cake specifications. Product drying and packaging is an integral part of the circuit. An x-ray emission spectrophotometer is to be the analytical tool for process control and most of the plant operations will be recorded and observed from a central control room. The mechanical features of the flowsheet layout, the basic chemistry involved, and anticipated operating economics are described. (auth)

23670 APPLICATION OF STATIC LEACHING TO MARGINAL URANIUM ORES. Gasos, P.; Josa, J. M.; Cordero, G.; (and others) (Junta de Energia Nuclear, Madrid). pp 159-71 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971). (In Spanish).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

Experience gained in applying the static leaching technique in Spain and its future prospects are discussed. The aim in applying this technique is to make feasible: the exploitation of small, isolated mines and of marginal fractions (250 ppM U_3O_8) obtained as by-products from normal deposits and processes requiring low investment and a minimum of staff and supervision. The possibilities of different circuits, the advantages and disadvantages of ion exchange and of extraction in the treatment of fertile liquids (with a high concentration of impurities) obtained from these processes, and the economics of these processes are discussed. The discussion is based on the performance of two portable plants, one processing 70 tons of coarse ore (160 to 450 ppM U_3O_8) per day by acid leaching in countercurrent solvent extraction, and the other processing 35 tons of clay minerals (500 ppM U_3O_8) per day by open-circuit acid leaching and ion exchange. A small plant under construction, which is designed to process 200 tons of highly altered low-grade ore (250 to 600 ppM U_3O_8) per day, is also described. Its operating program consists of primary breaking of the ore, grading, static leaching of coarse grains, leaching with stirring of fines, separation of sands, RIP (resin in pulp), sulfuric elution, and solvent extraction from clear liquids and eluates. (auth)

23671 ON-SITE LEACHING OR URANIUM ORES PREPARED IN UNDERGROUND WORKINGS. Harel, M.; Sugier, P. (CEN, Fontenay-aux-Roses, France). pp 173-84 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971). (In French).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

A method of recovering low-grade ores in underground workings by successive use of the bulk breaking and bulk leaching techniques is described. The method studied involves enrichment, during exploitation, of some deposits whose uranium content would not normally justify high production costs. The method reduces by two-thirds the work of conveying the mineralized mass to the surface. The ore mass is broken down and left in place and its metal content extracted by leaching. The expenses involved in mining, crushing, and grinding at the chemical plant and in the separation of solids and liquids after treatment, are thereby reduced. (auth)

23672 SULPHATING ROASTING: A WAY TO SOLUBILIZE URANIUM IN REFRACTORY MINERALS. Asmund, G.; Lundgaard, T.; Soerensen, E. (Danish Atomic Energy Commission, Risoe). pp 185-94 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

The lujavrites of the Ilimaussaq-intrusion in South Greenland constitute an easily accessible, but low-grade uranium resource. About thirty million tons of rock range between 300 and 600 ppM of U_3O_8. The uraniferous minerals: steenstrupine, monazite and pigment material, are rather refractory to conventional acid leaching. A practicable alternative is heating to 700°C in an atmosphere containing SO_3, whereby mainly the uranium is converted into sulfate. This process is called sulfating roasting. Some iron-containing minerals are of importance by acting as catalysts for the reaction $2SO_2 + O_2 \rightleftharpoons 2SO_3$, which makes possible the use of SO_2 + air as sulfating agent. The ore is ground to 82 to 84% minus 100 mesh and pelletized. The pellets are fed to the top of a moving bed, vertical shaft furnace in countercurrent with the SO_2–air mixture. A taking up of 4 wt % SO_3 corresponds to a reaction time of 15 to 20 min and a uranium recovery of 60 to 80% depending on the ore type, monazite giving the lowest yield. The cooled pellets are extracted with a minimum amount of water in a battery of percolators. The metals in the strong sulfate solution are separated by precipitation methods, rare earths by heating to 80°C, uranium by a special reduction, and $Na_2SO_4 \cdot 10H_2O$ by freezing. Zn is recovered electrolytically, and the barren acid liquor is recycled for use as binder in the pelletizing of fresh ore. There is no waste liquor to be disposed of, and the tailings are neutral and nontoxic. (auth)

23673 BACTERIA-BASED PROCESSES FOR THE TREATMENT OF LOW-GRADE URANIUM ORES. Gow, W. A.; McCreedy, H. H.; Ritcey, G. M.; (and others) (Dept. of Energy, Mines, and Resources, Ottawa). pp 195-211 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

The possibility of utilizing the ability of the ferrobacillus–thiobacillus group of bacteria to oxidize ferrous iron and to produce sulfuric acid and ferric sulfate from pyrite in the treatment of uranium ores was studied to collect the information needed to assess the technical and economic feasibility of bacteria-based leaching processes. All of the work was done with the uraninite–brannerite–uranothorite ore of the Elliot Lake, Ontario area as feed material. Laboratory and pilot plant studies to investigate the possibilities of applying the ferrobacillus–thiobacillus bacteria, under a variety of conditions of temperature and leach liquor compositions, to leach either coarse ore of up to several inches in size in surface heaps or in underground workings, or finely ground ore of about minus 100 mesh in stirred reactors are described. Investigations done to assess the applicability of ion exchange and solvent extraction processes for recovering uranium from the leach liquors so produced are also reported. (auth)

23674 BACTERIAL LEACHING OF URANIUM IN YUGOSLAVIA. Tesic, Z. P. (Microbiology Inst., Belgrade); Marjanovic, D. I. pp 213-21 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971). (In Russian).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

Data are presented on the bacterial extraction of uranium by autotrophic microorganisms and on the role of microorganisms in the leaching of low-grade ores and of minerals that are difficult to process by conventional leaching methods. Microbiological studies of uranium deposits were followed by an investigation of the geochemical role of bacterial flora. The very fact that microorganisms are present in uranium deposits in large numbers, together with their activity and their use in leaching experiments, has shown that they not only constitute a factor in the extraction of metals but are also capable of accelerating the oxidation of minerals and the extraction of uranium from ores. Uranium leaching studies were conducted on a laboratory scale under various conditions: with small quantities of acid, with an oxidizing agent, with pyrites, and with surface-active agents. The bacterial leaching of uranium in neutral-alkali media was also studied; so far

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little is known about the mechanism involved, but it is of scientific and practical interest. Investigations showed that the addition of small amounts of chemical agents such as sulfuric acid, ferric sulfate and Tween intensifies the bacterial extraction of uranium without making the process uneconomic. (auth)

23675 BACTERIAL OXIDATION OF WITWATERSRAND SLIMES. Mrost, M.; Lloyd, P. J. (Chamber of Mines, Johannesburg). pp 223-39 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

Bacterial oxidation of iron pyrites occurs naturally on residue dams of Witwatersrand gold mines, yielding ferric sulfate and sulfuric acid, which react with uranium-bearing minerals to produce soluble uranium sulfate. Examination of the various factors governing the bacterially assisted pyrite oxidation reaction established that access to air is rate-limiting. Methods are discussed for introducing air into slime material so as to increase the rate of pyrite oxidation, and therefore of uranium solubilization, to a level sufficient to permit the development of methods for the recovery of such uranium at an acceptable rate. (auth)

23676 URANIUM RECOVERY BY LIQUID-LIQUID EXTRACTION IN SOUTH AFRICA. Faure, A. (South African Atomic Energy Board, Pelindaba); Tunley, T. H. pp 241-51 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

In the South African uranium industry, the ion-exchange process is rapidly being replaced by a liquid-liquid extraction process known as the Purlex process. In this process, uranium is extracted directly from leach liquors by Alamine 336 (a mixture of trioctyl- and tridecylamines). Five full-scale plants are operating on this process, two more being constructed, and two are in the planning stage. A short description of the salient features of each plant is given, together with operating details. To obtain virtually 100% stage efficiency in the extraction section is a simple matter, but it is not easy to keep the solvent loss in the raffinate to acceptable limits. Mixer-settler design and operating variables are discussed. The use of coalescers for the recovery of solvent from the raffinate stream is considered. The addition of ammonia to the ammonium sulfate stripping circuit causes problems of control, and the various solutions to these problems are discussed. A practical system for the continuous make-up of ammonium hydroxide of standard strength is described. Static electricity caused by the pumping of solvent is not a hazard because of the high conductivity of the solvent. Fire hazards are considered and various control systems described. The purity of the product of various plants is given and problems involved in the reduction of the remaining impurities are discussed. (auth)

23677 LABORATORY-DEVELOPED IMPROVEMENTS IN THE RE-EXTRACTION/SEPARATION OF URANIUM AND MOLYBDENUM IN AN ORGANIC SOLVENT BY MEANS OF AMMONIUM CARBONATE. Mouret, P.; Sialino, E.; Sugier, P.; Vial, J. (CEN, Fontenay-aux-Roses, France). pp 253-66 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971). (In French).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

Alamine 336 containing uranium and molybdenum extracted by a sulfuric acid solution from ores mined in the Republic of the Niger is treated in countercurrent mixer-settlers with a solution of ammonium carbonate and ammonium sulfate. The uranium, which crystallizes out as uranyl ammonium tricarbonate, is calcined to an oxide containing 84% uranium and less than 100 ppM molybdenum. The molybdenum is recovered as a sulfite from a fraction of the mother liquors of the uranyl ammonium tricarbonate and calcined to an oxide containing 90% MoO_3; the other fraction is recycled. The process is intended for industrial use. (auth)

23678 AMINE EXTRACTION OF URANIUM, MOLYBDENUM, AND VANADIUM FROM ACID LEACH LIQUORS. Floh, B.; Abrao, A.; Calmon Costa, E. (Instituto de Energia Atomica, Sao Paulo, Brazil). pp 267-85 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

Several alternative schemes were evaluated for the extraction and separation of uranium, molybdenum, and vanadium values of sulfuric acid leach liquors. The work was conducted in connection with the development of an acid leaching process for the uranium-molybdenum ore from the Poços de Caldas Plateau in the State of Minas Gerais. Extraction conditions for uranium were established from data obtained from pure solutions and extrapolated to the leach liquors after investigation of effects in binary and ternary solutions. The establishment of optimized extraction conditions in pure solutions employed a sequential graphic optimization approach. (auth)

23679 COST REDUCTIONS IN ION EXCHANGE PROCESSING OF URANIUM ORES. Rosenbaum, J. B.; George, D. R. (Bureau of Mines, Salt Lake City). pp 297-309 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

Systems of countercurrent ion exchange offer opportunities for significant savings in the cost of processing uranium ores. A countercurrent, multistage ion-exchange column, initially developed for recovering uranium from dilute mine waters, also proved effective for handling clear solutions and slime pulps prepared by leaching uranium ores. In pilot plant tests, clear solutions and slime pulps containing up to 8% solids were processed at the exceptionally high flow rate of 15 US gallons per square foot per minute, with high recovery and efficient loading of resin. A single-stage ion-exchange column was developed for eluting uranium from resins under countercurrent flow conditions. Substantially complete elution can be achieved using only 2 to 4 volumes of solution per volume of resin. Because of simple design, low construction cost, high throughput rates, low maintenance, ease of automation, and reduced resin requirements, use of these types of ion exchangers enable substantial reductions in the cost of processing uranium ores. A cost estimate for a uranium-ore processing mill, using these ion-exchange columns in a resin-in-pulp system, shows that capital costs for such a plant would be about 27% lower than for a mill employing thickeners and solvent extraction or conventional ion exchange. In addition, a significant reduction in direct operating cost can be expected for the simpler and more readily automated plant. (auth)

23680 PRODUCTION OF URANIUM FROM A BRAZILIAN URANIFEROUS ZIRCONIUM ROCK. Amorim, H. L.; Blatt, Victoria (Administration de la Production de Monazite, Sao Paulo, Brazil). pp 311-19 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971). (In French).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

In Brazil, in the region of Poços de Caldas (Minas Gerais), there is a uraniferous zirconium rock known as caldasite (Caldasito), which consists of a mixture of zirconite and baddeleyite and contains a small amount of uranium. The present reserves in the occurrence are estimated at about 100,000 tons, apart from 22,500 tons that were mined and are stored at the site. A sample from this store has shown that it contains 63% $ZrSiO_4$ and 0.3% U_3O_8. Studies are being made on the chemical processing of this rock in order to obtain zirconium oxides as the main product and recover uranium as a by-product. The studies include solubilization of the ore by acid or alkaline methods. The method used in this plant consists in dissolving the ore in acid followed by solvent (TBP) extraction, in a nitric medium of the uranium and zirconium from the hydroxides so obtained. The cake shows a high content of the sulfate ion; before being dissolved in nitric acid it is washed with hot water, which removes all the soluble sulfates. The residue is dissolved in 4N HNO_3; a liquor containing zirconium and uranium with iron as the main impurity is thus obtained. This liquor, after acid treatment, is subjected to extraction by TBP-Varsol (30 vol. %). An extract containing practically the whole of the uranium, almost free from iron and totally free from zirconium, is obtained. After washing with a mixture of HNO_3 and $NaNO_3$, iron is eliminated from the organic phase, and uranium is re-extracted with sodium carbonate. Zirconium is precipitated from the raffinate with soda and then calcined to ZrO_2. (auth)

23681 EXTRACTION OF URANIUM FOR POTENTIAL RESOURCES. Gasos, P.; Josa, J. M.; Regife, J. M.; Hernandez, J. (Junta de Energia Nuclear, Madrid). pp 333-40 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971). (In Spanish).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

Studies are being carried out in Spain on the extraction of uranium from very low-grade materials and as an industrial by-product. The studies cover: (a) The physical concentration of sandstones and quartzites with low uranium contents (175 to 450 ppM). Zircon enrichment is achieved by differential crushing, and a uranium-rich zircon concentrate is obtained by floatation. Solubilization of uranium requires the breaking down of the zircon lattice: (b) The processing of low-quality coals. This process eliminates most of the inorganic material (limestones and gypsum), and calcination yields a material with 700 to 1300 ppM U_3O_8, from which uranium is solubilized by static leaching after sintering; (c) The extraction of uranium from phosphoric acid and from the by-prod-

uct of the fertilizer industry. The accent is on solvent extraction and on the selection of reagents; (d) The treatment of mine waters with U_3O_8 concentrations in the range 15 to 50 mg/liter, mainly by ion exchange. Tests carried out with natural water are being extended to the in situ leaching liquids; (e) The extraction of uranium as a by-product of the copper industry, acid effluents from the copper pyrites wastes. (auth)

23682 STUDY OF SOME PHENYL PHOSPHORIC ACIDS FOR EXTRACTION OF URANIUM FROM PHOSPHORIC ACID. Murthy, T. K. S.; Pai, V. N.; Nagle, R. A. (Bhabha Atomic Research Centre, Trombay, India). pp 341-50 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

The feasibility of recovering uranium as a by-product from commercial phosphoric acid is considered. Mono- and di-substituted phosphoric acids were prepared, using 4-octyl, 4-nonyl, and 4-chloro-2-benzyl phenols, and their use as extracting agents investigated. Detailed studies with octyl phenyl phosphate showed that the di-ester extracted hexavalent uranium from phosphoric acid solutions better than quadrivalent uranium, the reverse being the case with the mono-ester. Neutral organophosphorus compounds like tri-n-butyl phosphate (TBP), dibutyl butylphosphonate (DBBP) and tri-n-octylphosphine oxide (TOPO) added to the organic phase increased the extraction of uranium (VI) by the di-ester. With 5.5-5.8M phosphoric acid favorable distribution factors were obtained with 0.2M di-ester in conjunction with 0.1M DBBP. Uranium from organic phase could be stripped with carbonate solutions. Extraction of uranium (IV) with the mono-ester was also studied. Higher distribution factors were obtained in this case as compared to uranium(VI) extraction by di-ester. (auth)

23683 POSSIBILITIES FOR RECOVERY OF URANIUM AS A BY-PRODUCT IN THE PRODUCTION OF PHOSPHATE FERTILIZERS AND TRIPOLYPHOSPHATE. Deleon, Ana; Lazarevic, M. (Inst. for Tech. of Nuclear and Other Mineral Raw Materials, Belgrade). pp 351-61 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

The distribution of uranium in the various stages of the wet phosphoric acid production process as well as in its products is discussed. Commercially available solvents were used as uranium extractants. Two precipitation techniques were tested for recovering uranium as a by-product in the production of tripolyphosphate. (auth)

23684 PROCESS FOR THE RECOVERY OF URANIUM AS A BY-PRODUCT OF PHOSPHORIC ACID VIA HC1 ACIDULATION FROM UNDISSOLVED RESIDUE. Ketzinel, Z.; Yakir, D.; Rosenberg, J.; (and others) (Israel Atomic Energy Commission, Beer-Sheva). pp 363-76 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

Various processes for the production of phosphoric acid, using acids other than sulfuric for acidulation, were developed. One such process is the IMI (Israel Mining Industries) process using hydrochloric acid. A relatively small amount of undissolved solids is obtained when phosphate rock is attacked by hydrochloric acid (as compared to sulfuric acid acidulation). If uranium could be made to remain in this residue, it is possible to obtain a solid containing over 0.1% uranium. The original rock phosphate contains 0.01 to 0.15% uranium. Such a solid is already crushed, ground, and non-acid-consuming. The major part of the uranium remains in the undissolved residue when acidulation is carried out under reductive conditions, which are achieved by introducing iron powder during acidulation. The uranium is then acid leached with dilute hydrochloric acid and oxidizing agent. A precipitation of 1 to 2% uranium is obtained by neutralizing the leach liquor to pH 2. In one more step a concentrate of 60 to 70% uranium is obtained by carbonate leach and reprecipitation with NaOH. Overall uranium recovery is 50%. (auth)

23685 UNDERGROUND LEACHING: A METHOD FOR THE ECONOMIC EXTRACTION OF URANIUM FROM LOW-GRADE ORES. Zefirov, A. P.; Nevskii, B. V.; Bakhurov, V. G.; (and others) (State Committee on the Utilization of Atomic Energy, Moscow). pp 377-88 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971). (In Russian).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

A method for uranium extraction is described in which the product is delivered to the surface not in the form of ore but in the form of a uranium-containing solution. The uranium is leached out by a chemical reagent at the site of the ore deposit. A brief description is given of the two principal schemes for the extraction of uranium by this method from rocks and sedimentary ores, located under stratified conditions, and the advantages and disadvantages of the method are noted. Under certain conditions the underground leaching method can be economically applied to ores with a lower uranium content than is required for conventional mining methods. (auth)

23686 RECOVERY OF URANIUM AS A BY-PRODUCT IN THE PROCESSING OF GOLD ORES. A REVIEW OF PROGRESS. Finney, S. A. (Nuclear Fuels Corp. of South Africa (Pty) Ltd., Johannesburg). pp 389-405 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

The recovery of uranium from gold-bearing ores containing relatively small quantities of uranium engenders certain economic and extractive aspects that differ markedly from those that occur when the ore contains primarily uranium in significantly higher concentrations. The progess in recovery of uranium since it was initially discovered in South African gold-bearing ores is reviewed. Extraction techniques progressively adopted up to present-day operations are considered, and indications of future developments are given. (auth)

23687 PROCESSING OF A URANIFEROUS ZIRCONIUM ORE. Brown, A. E. P.; Calmon Costa, E. (Instituto de Energia Atomica, Sao Paulo, Brazil). pp 407-14 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

A processing scheme for caldasite, a mixture of zircon and baddeleyite abundant in the Poços de Caldas Plateau, was investigated aiming at a joint recovery of the uranium and zirconium values of the ore. The uranium–zirconium and iron–zirconium separations were done by precipitation of basic zirconium sulfates. The uranium was recovered by extraction of the mother liquor from the first zirconium precipitation by employing Alamine 336 in an inert diluent. End products are sodium diuranate and a commercial grade of zirconium oxide. Estimated production costs compared favorably with Brazilian import prices. (auth)

23688 PROCESSING OF CLAY-PYRITE ORES CONTAINING URANIUM, PHOSPHORUS, AND RARE EARTHS. Zefirov, A. P.; Skorovarov, D. I.; Nevskii, B. V.; (and others) (State Committee on the Utilization of Atomic Energy, Moscow). pp 417-23 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971). (In Russian).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

Characteristics of clay–pyrite ores containing uranium, phosphorus, rare earths and certain other valuable components are given and their concentration by mechanical methods described. Data are also given on the processing of the concentrate by the nitrate and sulfate methods and the processing of the initial ore by means of calcining with common salt. The schemes developed permit the integral utilization of the raw material and reutilization of the principal reagents used during processing. (auth)

23689 TECHNOLOGICAL STUDIES OF THE EXTRACTION OF URANIUM AND OTHER VALUABLE COMPONENTS FROM URANIUM-CONTAINING BITUMINOUS SHALES. Zefirov, A. P.; Ivanov, G. F.; Nosov, V. D.; Smirnov, I. P.; Gaevoi, P. A. (State Committee on the Utilization of Atomic Energy, Moscow). pp 425-35 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971). (In Russian).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

Uranium-containing oil shales are an extemely widespread variety of low-grade uranium ores. The following lines of research on the technology of the extraction of uranium and other valuable components from oil shales are covered: (1) Investigation of the mineralogical and chemical composition of shales and also of the possibility of their concentration by mechanical methods; (2) Investigation of the technology of leaching moist shales: (a) Percolation leaching of freshly and previously mined shales; (b) Bacterial leaching; (c) Acid autoclave leaching; (3) Investigation of combined schemes for the integrated utilization of shales: (a) Calcining with subsequent acid leaching of the uranium and molybdenum from the calcine shale; (b) A technique involving the application of energy for the integrated utilization of shales; (c) Various methods for the chlorination of shale semicoke. (auth)

23690 •ECONOMIC RECOVERY OF LOW-GRADE URANIUM VALUES FROM WITWATERSRAND ORES. A REVIEW OF

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PROGRESS. Lloyd, P. J. (Chamber of Mines, Johannesburg). pp 437-54 of Recovery of Uranium. Vienna; International Atomic Energy Agency (1971).

From Symposium on the Recovery of Uranium, Sao Paulo, Brazil. See STI/PUB-262; CONF-700836.

Significant reserves of low-grade (0.1 to 0.3 lb/ton) uranium that cannot be recovered economically by conventional procedures are to be found in the residue dams of Witwatersrand gold mines. Autogenous oxidation of the pyrite content of the dams to ferric sulfate and sulfuric acid, and hence the in situ solubilization of uranium, provide the basis for the development of a recovery process that, since it avoids the conventional expensive acid leaching step, may be applicable to low-grade material. Possible recovery procedures based on in situ solubilization of uranium are reviewed and the results of pilot-scale trials are reported. (auth)

23691 KINETICS OF ION EXCHANGE. VII. MEASUREMENTS IN THE FILM DIFFUSION REGION. Talasek, V.; Eliasek, J. (Inst. of Chemical Tech., Prague). Collect. Czech. Chem. Commun.; 36: 77-83(Jan 1971).

From the oscillometrically measured exchange half times the film diffusion data of a number of cations, organic bases on Dowex 50W X 16 with respect to the H^+ ion, as well as data of anions and anions of organic acids on Dowex 1 X 8 with respect to the OH^- ion were calculated. The total concentration of external solution was $5 \cdot 10^{-3}$ val/l. Integral kinetic data may be interpreted by means of the Nernst–Planck equation or transport coefficients in the ternary system. Effect of some variables as, for example, concentration of the external solution, charge, mobility, hydration, and selectivity of ions on the kinetics of exchange in individual systems are discussed. (auth)

23692 APPARATUS FOR SEPARATING URANIUM FROM AN AQUEOUS SOLUTION. Ploger, F.; Vietzke, H. (to NUKEM Nuklear-Chemie und -Metallurgie Gesellschaft mbH). Canadian Patent 859,024. 22 Dec 1970. Priority date 14 May 1969, Germany.

A uranium solution is cycled from a vessel through mixing nozzles mounted in precipitating tubes or ducts and back into the vessels. The gases produced in the vessel are passed into a washing tank. (F.S.A.)

23693 ELUTION REQUIREMENTS FOR ION-EXCHANGE SEPARATION OF URANIUM ISOTOPES. Gonda, K.; Ohnishi, A.; Narita, D.; Murase, T. (Power Reactor and Nuclear Fuel Development Corp., Tokai). J. Chromatogr.; 55: 395-401(3 Mar 1971).

The necessary flow rate and the effective bed length for the ion-exchange separation of uranium isotopes were calculated using Rosen's theory. The applicability of Rosen's theory was verified using the isotope exchange of $^{235}U-^{238}U$ between the anion-exchange resin bed and 8.4M hydrochloric acid. The effective feed rate and the estimated column bed length were 8.6×10^{-3} cm/sec and 3.4×10^2 cm, respectively, for the linear isotherm system of U(IV) using 8.4M hydrochloric acid and the anion-exchange resin, Diaion SA10. (auth)

23694 SEPARATION OF UNBOUND IODIDE IN ^{125}I-LABELED ANTIPYRINE. Yipintsoi, Tada; Gustafson, Donald C.; Bassingthwaighte, James B. (Mayo Clinic, Rochester, Minn.). J. Nucl. Med.; 12: 149-52(Apr 1971).

Iodo antipyrine labeled with ^{125}I was studied to determine the presence of unbound iodide and to separate it from the labeled compound. Three methods of separating the unbound iodine were studied: paper chromatography, thin-layer chromatography, and high-voltage electrophoresis. The effects of various variables on the amount of unbound iodine were determined. (M.C.G.)

23695 HYDROFLUORINATION OF U/Th OXIDES AND CARBIDES WITH A COATING OF PYROCARBON/SILICON CARBIDE/PYROCARBON IN THE CONTEXT OF DRY REPROCESSING OF NUCLEAR FUELS CONTAINING THORIUM. Kreutz, R.; Kuhrt, W.; Massonne, J. (Kali-Chemie AG, Hanover). Kerntech. Atomprax.; 13: 21-3(Jan 1971). (In German and English).

It is possible to remove silicon carbide completely from oxidic and carbidic U/Th particles with a pyrocarbon/silicon carbide/pyrocarbon coating by grinding, treatment with oxygen and hydrofluorination with HF/O_2 at a temperature of 500°C. In this process, the U/Th component is converted into fluorides. (auth)

23696 SEPARATION OF MoF_6 AND UF_6 BY SORPTION ON NaF IN THE CONTEXT OF DRY REPROCESSING OF NUCLEAR FUELS CONTAINING THORIUM. Kuhrt, W.; Kreutz, R.; Massonne, J. (Kali-Chemie AG, Hanover). Kerntech. Atomprax.; 13: 17-20(Jan 1971). (In German and English).

The sorption of MoF_6 on NaF and its desorption over a range of temperatures, flow rates, and durations were investigated. Optimal conditions are given for the separation of UF_6-MoF_6 mixtures by joint sorption of both fluorides on NaF followed by fractionated desorption. (auth)

23697 USA STANDARD: PROPOSED DEFINITION OF RADIOACTIVE WASTE CATEGORIES. ANSI N 5.8 1967. New York; American Institute of Chemical Engineers (1967). 7p. Available from American National Standards Inst., New York.

The major parameter used for waste categorization proposals is the ratio of radionuclide concentration in the waste at the time of consideration to the maximum permissible concentration of the same waste constituents in water, air, or solids. Five major categories of wastes, classes A, B, C, D, and E, in ascending order of radionuclide concentration, are proposed. (M.C.G.)

23698 MANNER OF PROCESSING PLUTONIUM-CONTAINING URANIUM FUEL FROM NUCLEAR REACTORS. Larsson, Alf Harald; Hultgren, Ake Valdemar (to Aktiebolaget Atomenergi). U. S. Patent 3,560,169. 2 Feb 1971. Priority date 21 Apr 1967, Sweden.

In the recovery of plutonium and uranium from the core of a nuclear reactor by dissolving the fuel elements in an aqueous solution of, for instance, nitric acid, the highly irradiated central portions of the core are dissolved separately from those of the less irradiated peripheral portions to form separate first and second aqueous solutions that are separately extracted with organic solvents. The first solution is selective to plutonium relative to uranium and fission products and the second one is selective to plutonium and uranium relative to fission products. The residue of the first solution is combined with the second solution. (Offic. Gaz.)

23699 EXTRACTION OF THORIUM, LEAD, AND IRON(III) AS COMPOUNDS OF CAPROIC ACID. Pietsch, R. (Univ., Graz). Anal. Chim. Acta.; 53: 287-94(Feb 1971). (In German).

The possibility of extracting thorium, lead and iron(III) with caproic (n-hexanoic) acid as their caproates into chloroform is described. Experimental conditions are detailed and examples of single extraction and separation methods are given. The composition of the metal compounds in the chloroform layer was established. (auth)

23700 PROCESS FOR CARRYING OUT ISOTOPE EXCHANGES. Bourgeois, Y.; Lehman, J.-Y.; Lefrancois, B.; Briec, M.; Rostaing, M. Canadian Patent 863,234. 9 Feb 1971. Priority date 16 Aug 1966, France.

A process is described for effecting isotope exchanges between ammonia, deuterated ammonia, hydrogen, and deuterium in order to produce ammonia enriched with deuterium. The method consists of feeding synthesis gases ($N_2 + 3H_2$) between two consecutive exchange towers, circulating in countercurrent fashion in the first tower the synthesis gases and the ammonia formed from the synthesis gases. In the second tower the ammonia that exits from the first tower is circulated countercurrently with a gas resulting from the cracking of the deuterated ammonia taken at the exit of the second tower. This second "hot" tower is kept at a temperature which is 10 to 100°C higher than the temperature in the first or "cold" tower. A flow sheet traces the gas circulation. (F.S.A.)

23701 USE OF EXTRACTION DURING SEPARATION AND PARTING OF RARE METALS. Bol'shakov, K. A.; Korovin, S. S. Zh. Vses. Khim. Obshchest. im. D. I. Mendeleeva; 15: 380-7 (1970). (In Russian).

Rubidium, cesium, gallium, indium, scandium, yttrium, and lanthanides are used as examples in showing that extraction can be used to solve complex technical problems in separation. Basic patterns of extraction behavior and the formation of coordination compounds are considered. The behavior of metals in aqueous and organic solutions is explained from the viewpoint of the peculiarities of atomic structure. The qualitative characteristics of the extraction of metals by extractants of different classes are given. (JPRS)

23702 EXTRACTION AND SEPARATION OF ^{137}Cs AND ^{86}Rb BY MEANS OF 4-t-BUTYL-2-(α-METHYLBENZYL) PHENOL. Rais, J.; Krtil, J.; Chotivka, V. (Inst. of Nuclear Research, Rez, Czech.). Talanta; 18: 213-18(Feb 1971).

The extraction of caesium-137 and rubidium-86 by a solution of 4-t-butyl-2(α-methylbenzyl)phenol in n-octane and tetrachloromethane was investigated. The separation of rubidium and caesium was performed by the Craig method and by reversed-phase extraction chromatography. (auth) (UK)

EARTH SCIENCES

Geology and Hydrology

Refer also to abstracts 23718, 23891, 23892, 24077, 25625, and 25960.

23703 (AECL–3800) DEUTERIUM CONTENT OF CANADIAN WATERS. II. Brown, R. M.; Robertson, E.; Thurston, W. M. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Jan 1971. 60p. Dep. NTIS (U. S. Sales Only). AECL $1.50.

The deuterium content of precipitation and surface waters at about 100 sites across Canada has been measured mass spectrometrically. Data has been obtained for a two-year period at most sites. The distribution patterns observed are discussed in relation to meteorological and hydrological factors. A seasonal range of up to 20 ppM has been observed for precipitation, but not more than 4 ppM for surface waters at individual sites. Geographically, concentrations range from 155 ppM in coastal seawater to a low of 125 ppM in winter precipitation at northern sites. The lower Great Lakes and streams draining coastal areas have the highest deuterium content (148 to 149 ppM) of fresh waters in Canada, hence these areas stand out as prime locations for heavy water production plants. Additions to the bibliography on natural deuterium concentrations presented previously are included. (auth)

23704 (BNWL–1539) RADIOLOGICAL STATUS OF THE GROUNDWATER BENEATH THE HANFORD PROJECT, JANUARY–JUNE 1970. Essig, T. H. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Dec 1970. Contract AT(45-1)-1830. 23p. Dep. NTIS.

An evaluation of ^{106}Ru and ^{3}H concentrations measured in the unconfined groundwater beneath the Hanford Project during the first half of 1970 showed that the zones of detectable contamination extend in an easterly to south-easterly direction from 200-E Area as observed in the past. The few locations for which average groundwater concentrations exceeded the Concentration Guide (CG) for ^{106}Ru were all within either the 200-E or 200-W Areas. Water from only one well located outside of the 200 Area fences (Well 699-35-70) indicated a ^{3}H concentration greater than the CG. The highest average concentration of ^{51}Cr measured in unconfined groundwater within or near the 100 Areas (Well 199-K-20) was less than 1 percent of the CG for ^{51}Cr (2000 pCi/ml). Concentrations of uranium, the principal radionuclide observed in 300 Area groundwater, averaged less than 0.5 pCi/ml (<3 percent CG). Although water from several wells with piezometer tubes extending to confined groundwater aquifers was sampled and analyzed, all such samples had gross beta concentrations less than the analytical limit (0.2 pCi/ml). Nitrate ion concentrations greater than 10% of the Public Health Service recommended drinking water limit of 45 ppM were observed in most groundwater samples from wells surrounding the 200 and 300 Areas. However, groundwater from these zones is not consumed by humans or animals. (auth)

23705 (USGS–474-85) WELLS AND SPRINGS IN CALIFORNIA AND NEVADA WITHIN 100 MILES OF THE POINT 37°15' N., 116°25' W., ON NEVADA TEST SITE. Thordarson, William; Robinson, B. P. (Geological Survey, Denver, Colo.). 1971. Contract AT(29-2)-474. 178p. (NTS–227). Dep. NTIS.

Studies of published and unpublished geologic and ground water data for an inventory of 6,032 wells and 754 springs in parts of Inyo and Mono Counties, California, and Clark, Esmeralda, Lincoln, and Nye Counties, Nevada, are reviewed. It was found that a complex sequence of granitic, metamorphic, volcanic, and sedimentary rocks of Precambrian to Holocene age are present in the study area. Rocks of lower Precambrian age are metamorphic. These rocks can be divided into five principal types: valley fill, volcanic, carbonate, clastic, and metamorphic and granitic. The valley fill, which produces large amounts of water, is the best aquifer; and it contains the largest number of wells. The carbonate and the volcanic rocks produce small to large amounts of water from fractures or solution cavities. The clastic rocks and the metamorphic and granitic rocks produce very little ground water. The greatest concentration of wells in the study area was in the Las Vegas area, which has 79 percent of the total wells inventoried. The Las Vegas area has less than 1% of the springs inventoried. The major uses of ground water listed in order of abundance, for the area exclusive of Las Vegas, are irrigation, domestic, public supply, and industrial. The major uses of ground water listed in order of abundance in the Las Vegas area are domestic, irrigation, public supply, and commercial. (auth)

23706 (USGS–474-106) CALCULATED IN SITU ROCK DENSITY FROM GRAVITY OBSERVATIONS, UA-1 (CANNIKIN) EMPLACEMENT HOLE, AMCHITKA ISLAND, ALASKA. Healey, D. L. (Geological Survey, Denver, Colo.). 1971. Contract AT(29-2)-474. 10p. Dep. NTIS.

Gravity observations were made on the ground surface and at a depth of 5,854 feet in drill hole UA-1. Two attempts to measure the free-air gradient utilizing the headframe over the drill hole were unsuccessful owing to mechanical vibrations in the structure. Because of the uncertainty in the measured free-air gradients these values were discarded and the average value (0.09406 mgal/ft) was used in the calculations. The calculated in situ bulk density was 2.36 g/cc. The weighted average bulk density determined from 47 core samples taken in the adjacent UAE-1 drill hole was also 2.36 g/cc. An analysis of selected portions of density logs provides an in situ bulk density of 2.37 g/cc. (auth)

23707 NATURAL RADIOACTIVITY OF JURASSIC POLYMICTIC SANDY-ARGILLACEOUS DEPOSITS OF THE MANGYSHLAK PENINSULA. Larionov, V. V.; Nefedova, N. I. Tr., Mosk. Inst. Neftekhim. Gazov. Prom.; No. 89, 47-56(1969). (In Russian).

It is shown that the magnitude of γ activity of rocks in the polymictic deposits can be used, as well as in sandy-agrillaceous deposits with quartz base, for evaluating the degree of their agrillaceous content. Tabulated data are given on the γ activity of various fractions of polymictic rocks of Jurassic period and the mean content of K, Th, and U in various cross sections of the Zhertybai oil deposit on the Mangyshlak peninsula. (R.V.J.)

23708 ^{210}Pb-ATMOSPHERIC DEPOSITION IN LICHEN-CARPETS IN NORTHERN SWEDEN DURING 1961–1969. Persson, B. R. (Lund Univ., Sweden). Tellus; 22: 564-71(1970).

The ^{210}Pb-content of lichen-carpets collected in northern Sweden (62.3°N, 12.4°E) from 1961 until 1969 was studied. The analytical method used was wet ashing with nitric and perchloric acid and spontaneous deposition of ^{210}Pb was measured with a silicon-surface-barrier detector. No maximum ^{210}Pb-content in lichen was found in 1963 to 1965 which could be compared with that previously found for ^{137}Cs, ^{55}Fe and ^{90}Sr, which were released by nuclear-weapons tests during 1961 to 1962. Thus there was no special evidence of any release of significant amounts of artificial ^{210}Pb-area-content of lichen during 1962 to 1968. The deposition rate of ^{210}Pb was estimated to be 1.7 ± 0.3 nCi/m^2 a. The effective half life for elimination of ^{210}Pb from the lichen-carpet was estimated to be 7 ± 2 a. The vertical distribution of ^{210}Pb in the lichen-carpet was also studied, and the highest concentrations were found in the top layer. (auth) (Sweden)

23709 MOISTURE MEASUREMENT IN THIN SOIL LAYERS BY ABSORPTION OF GAMMA-RAYS IN A CAPILLARY POROUS BODY. Kuehn, W.; Handl, J. (Gesellschaft fuer Strahlenforschung, Hanover). Kerntech. Atomprax.; 13: 15-17(Jan 1971).

A classical and a nuclear method was combined to measure the moisture content in thin soil layers. The advantage is a high spatial resolution. The experiments proved that the attenuation of gamma-rays due to the uptake of water into a clay cylinder is high enough to be continuously registered by relatively simple methods. The results also indicate that the method provides high sensitivity at low moisture contents. (auth)

23710 PHYSICAL BASIS FOR PULSED NEUTRON WELL-LOGGING. Chrusciel, Edward; Massalski, Jerzy; Starzec, Antoni. Acta Geophys. Pol.; 18: 355-94(1970). (In Polish).

The theoretical basis of pulsed neutron well logging is discussed. The known methods of measuring the time distribution of thermal neutrons as well as gamma photons from the neutron capture reaction are also discussed. The time distribution of thermal neutrons and photons depends on length of the probe, kind of detector, bore-hole diameter and filling rock porosity, water mineralization and saturation of the deposit by water, crude-oil or gas. The field methods for determining the mean lifetime of the thermal neutrons are described. These methods are compared with other geophysical techniques. (auth)

23711 RADIATION TECHNIQUES AS MEANS OF IMPROVING THE EFFICIENCY OF WATER USE. Barrada, Y. pp 168-78 of Isotopes and Radiation in Investigations of Fertilizer and Water

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Use Efficiency in Countries of Asia and the Far East. Vienna; International Atomic Energy Agency (1970). (CONF-690418-3).

From Use of isotopes and radiation in investigations of fertilizer and water use efficiency meeting; Bangkok, Thailand (21 Apr 1969).

Irrigation efficiency and water use efficiency (which allows for evapotranspiration) are considered in a general and theoretical way. Water use efficiency studies can lead to the best possible use of limited amounts of water, which in turn would increase production of food and fibers. Furthermore, the choice of crops and crop rotation and a choice of the most profitable irrigation projects can be formulated on a sound economic basis. The use of neutron moisture meters is strongly favored, and its advantages are enumerated. Long-term studies on moisture content and density of the same volume of soil are useful. Density measurements are carried out using a gamma density probe. The use of surface probes is discussed, as are the two-well gamma probe, and beta gaging technique. (INIS)

23712 COMPARATIVE INVESTIGATION OF THE GAMMA-RAY SPECTRUMS OF URANIUM ORE AND RADON LOCATED IN A BOREHOLE. Serdyukova, A. S.; Doshchechkin, V. P. Izv. Vyssh. Ucheb. Zaved., Geol. Razved.; No. 9, 112-17(1969). (In Russian).

23713 CONSIDERATIONS ON THE METROLOGICAL PARAMETERS IN RADIOHYDROLOGICAL MEASUREMENTS. Dinescu, L.; Gaspar, E. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 15: 911-22(1970).

On the basis of an original theory a manner for determining theoretically and experimentally the precision and sensitivity of radioactive tracer techniques for the estimation of the flow velocity of underground waters is shown. The theory was verified by means of experimental models and the factors which influence the precision of flow velocity measurements were computed as functions of various experimental parameters. Some recommendations are given on the manner of proceeding in order to minimize the inaccuracies of the methods employed. (auth)

23714 PROCEDURAL METHOD OF ESTIMATING THE THORIUM–URANIUM RATIO FOR ROCKS, USING ARS AIRBORNE RADIOMETERS. Tarutin, V. A. Razved. Geofiz.; No. 28, 56-70(1968). (In Russian).

The problems of the optimum calibration of airborne radiometers on the basis of ore samples are examined, and methods are proposed of increasing the accuracy of field measurements and processing the results obtained. Numerical values of the correlation coefficients K_U and K_{Th} are recommended. Original master curves are presented for calculating the Th: U ratio of the rocks in places where there are gamma anomalies. Methods of increasing the reliability of airborne measurements of the Th: U ratio are proposed, and the form of representation of the final results is considered. The conclusions are illustrated by practical examples and appropriate graphic material. (Geophys. Abstr.)

Meteorology

Refer also to abstracts 23772, 23800, 24010, 24075, 24128, 24130–24133, and 25718.

23715 (ARLV-351-17) WEATHER AND FALLOUT STUDIES FOR INTEROCEANIC CANAL ROUTES 17 AND 25. Final Report. IOCS Memorandum ESSA-6. Ferber, Gilbert J.; Palmer, Terrance R. (Environmental Science Services Administration, Silver Spring, Md. Air Resources Labs.). Aug 1970. Contract SF-54-351. 140p. (ERLTM-ARL-24). Dep. NTIS.

For Atlantic-Pacific Interoceanic Canal Study Commission, Washington, D. C.

The results of weather and fallout studies on two proposed routes for nuclear excavation of a sea-level canal across the American Isthmus are summarized. These routes are Route 17 in the Darien region of Panama and Route 25 in northwest Colombia. The radiation safety concept for nuclear excavation calls for evacuation of a pre-selected exclusion area and restricting detonations to days when weather conditions would confine almost all fallout to that area. A tentative exclusion area is selected for each route, frequency of favorable weather conditions is investigated, and estimates are made of potential radiation doses from fallout and rain scavenging of nuclear debris. From the meteorological standpoint, nuclear excavation appears to be feasible on both routes and neither route has a clear advantage over the other; however, under the nuclear excavation plans studied, fewer people would require evacuation on Route 25. On either route, the detonation schedule would encounter lengthy weather delays if conservative safety criteria are imposed because of uncertainties regarding fallout and airblast effects resulting from nuclear excavation. (auth)

23716 (NYO–3847-2) STUDIES ON COLLOIDAL PARTICLES: SCAVENGING OF AEROSOL PARTICLES BY A FALLING MACROSCOPIC PARTICLE. Progress Report, January 1, 1970–December 31, 1970. Kerker, Milton (Clarkson Coll. of Tech., Potsdam, N. Y. Div. of Research). Jan 1971. Contract AT(30-1)-3847. 53p. Dep. NTIS.

The collection efficiency of water droplets (0.71 to 2.54 mm radius) freely falling through a silver chloride aerosol consisting of a relatively uniform distribution of spheres with radii in the range of several tenths of a micron was studied. The droplets accelerated for a distance of 30 cm prior to entering the 130 cm aerosol chamber. The particle size distribution of the aerosol was determined by light scattering. The amount of AgCl scavenged by the droplet was analyzed by a very sensitive colorimetric technique. Collection efficiencies measured were extremely low, dropping off sharply from a value of 3.1×10^{-4} for a 2.54 mm droplet to a minimum of 6.3×10^{-6} for a 0.94 mm droplet, and then it appeared to rise again for smaller droplets. There did not appear to be any significant trends with particle radius which ranged from 0.2 to 0.5 μm radius. For the three smallest droplets the data correlated well with the Péclet number $E = 1.81\ Pé^{-\frac{2}{3}}$ suggesting that the mechanism of collection was Brownian diffusion through the streamlines. For larger droplets there was no correlation with either the Péclet or the Stokes numbers. In view of the large Reynolds numbers for these cases, the mechanism may involve the eddies in the wake of the droplet with enhanced collection on the backside. (auth)

23717 ARTIFICIAL RADIOACTIVITY OF GROUND-LEVEL AIR, PRECIPITATION, AND DUST IN STUTTGART–HOHENHEIM IN THE YEARS 1963–1968. Wieser, P. H.; Woerner, F. (Univ., Hohenheim, Ger.). Meteorol. Rundsch.; 23: 99-101(Jul-Aug 1970). (In German).

Total β-activity and ^{90}Sr content were measured in ground-level air, precipitation, and dust. Monthly data for both factors decreased consistently from 1963 until 1967. Throughout 1968, however, values significantly exceeded those of 1967. The increase resulted from Chinese nuclear test explosions. Because of the latter, the long term clearance of ^{90}Sr could not be studied. Throughout the period from 1963 through 1965, ^{90}Sr decreased approximately as an exponential function with a mean duration of 16 months. From April to December 1968, measurements were also made of ^{210}Pb in precipitation and dust. (H.B.G.)

23718 ENVIRONMENTAL RADIOACTIVITY, MONCLOA STATION (MADRID). Energ. Nucl. (Madrid); 14: 67-8(Jan-Feb 1970). (In Spanish).

The total β activity of atmospheric dusts and drinking water measured during January and February at the Moncloa Station is shown graphically. The ^{90}Sr activity in foods is tabulated. (J.S.R.)

Mineralogy and Exploration

Refer also to abstracts 23712, 23726, and 23899.

23719 SOME PECULIARITIES OF BIOTITE ASSOCIATED WITH URANIUM MINERALS. Rakovich, F. I. Konst. Svoistva Miner.; No. 3, 140-4(1969). (In Russian).

The investigations showed that the biotite characteristics in zones of uranium mineralization differed from the properties of biotite outside of ore zones. Under a microscope the biotite under study was dark brown. The pleochroism of the mineral changed from dark reddish-brown (Ng) to light brown or nearly colorless (Np). The refractive index was $Ng' = Nm' = 1.687 \pm 0.002$. The chemical composition of the biotite from uranium mineralization zones was characterized by a high content of trivalent iron in comparison with the biotite of schists. The oxidation of iron in the investigated biotite took place apparently at comparatively high temperatures during the period of uranium ore-formation and partially after it as a result of radioactive emanation of uranium minerals. (auth)

23720 PROPERTIES OF CERTAIN URANIFEROUS DEPOSITS IN PAKISTAN. Fernandez Polo, J. A. (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 14: 19-29(Jan-Feb 1970). (In Spanish).

The essential characteristics of the Pakistan uraniferous deposits in the Dera Ghazi Khan Desert are reported. The uranium

enrichments from supergenic processes during the Miocene, consisting of continental deposits of sandstone, are discussed. The possibilities of the zone are estimated as very superior to the lenticular outcroppings; its type corresponds to some sedimentary ores of the U.S.A. Some reference is made to the visit made to deposits of the placer type in the Indus River. Geological observations to examine promising terrain are also reported. (tr-auth)

23721 GEOLOGY, STRUCTURE, AND ORIGIN OF URANIFEROUS DEPOSITS IN SALAMANCA. Fernandez Polo, J. A. Energ. Nucl. (Madrid); 14: 99-118(Mar-Apr 1970). (In Spanish).

The investigation of the uraniferous ores in the Salamanca Province of Spain is described. The geological characteristics are those of a peneplain platform on the paleozoic base in which appear residual scales of more or less metamorphized metasediments, in some of which are found uraniferous deposits. Each zone appears modified by alpine tectonics which determines the appearance of brecciated areas particularly favorable for enrichment. The genetic processes are defined as supergenic movements and depositions with a marked surface and descendent character which affects, together with the tectonization, the morphology, deepness, and heterogeneity of the mineralized masses. (tr-auth)

Oceanography

Refer also to abstract 23528.

23722 RESEARCH ON THE VERTICAL DISTRIBUTION OF RADIOACTIVITY IN THE SEDIMENT OF THE LIGURIAN SEA. Schreiber, B. (Univ., Parma, Italy); Cerrai, E.; Triulzi, C.; Tassi Pelati, L.; Mezzadri, M. G. G. Fis. Sanit. Prot. Radiaz.; 13: No. 1, 1-19(1969). (In Italian). (CISE-E-723).

The vertical distribution of the total β radioactivity of cores taken from the Ligurian Sea from 1963 to 1968 was reported. The radiochemical analysis for the determination of the principal natural and artificial radionuclides in these core samples was given. The results showed that the maximum radioactivity was measured in the first layers of the core of 1963. The surface activity then progressively decreased. Stratification of the sediments and subsequent sinking of the more radioactive layers were confirmed. The characteristic pattern of the radioactivity of the cores can be determined by four factors: sedimentation and encirclement of the artificial fallout radionuclides in the sand of the sea bottom; variations of the quantity of radionuclides with time; decay of the radioisotopes with time; and the diffusion of the radionuclides in the sediments. (J.S.R.)

XUM

ENGINEERING

Nuclear Explosions

Refer also to abstracts 23523, 23705, 23715, and 24135.

23723 (ORNL-TM-3337) CHEMICAL APPLICATIONS OF NUCLEAR EXPLOSIONS (CANE): PROGRESS REPORT FOR OCTOBER 1–DECEMBER 31, 1970. Arnold, W. D.; Crouse, D. J. (comps.) (Oak Ridge National Lab., Tenn.). 10 Mar 1971. 16p. Dep. NTIS.

Increasing the exposure time of Green River oil shale to tritiated hydrogen from 44 to 85 days had no effect on the tritium contamination of the shale or of the oil retorted from the shale. The contamination of both the shale and the oil increased with increasing shale exposure time to 44 days. In tests simulating the storage of natural gas in a cavity formed with nuclear explosives, the tritium contamination of methane stored in contact with contaminated Lewis shale was extremely low and decreased sharply after the first two contacts of fresh methane with the shale. Adding water to the contaminated shale, which would reduce the concentration of tritiated water in the simulated storage cavity, before contact with methane reduced the tritium contamination of the methane to near the detection limit. Removal of tritiated water from contaminated shale by purging with moist air was attempted with limited success. (auth)

Facilities and Equipment

Refer also to abstracts 24271, 24658, 25076, and 25108.

23724 (EIR-187) HEAT EXCHANGERS FOR GAS TURBINE FAST REACTORS. Lys, L. A.; von Allmen, I. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). Oct 1970. 14p. (CONF-700430-1). Dep. NTIS (U. S. Sales Only).

From Conference on Nuclear Gas Turbines, London, England.

The use of large regenerators and coolers clearly affects the efficiency of gas turbine fast reactor plants. This equipment, however, generally represents a significant cost item and therefore, it is necessary to determine a compromise between the cost savings resulting from the increased efficiency and the capital expenditure for the equipment required. The work which has been performed by the Swiss Federal Institute for reactor research with the participation of Swiss industry with the aim of selecting the proper design of the regenerator and coolers is described. (auth)

23725 (EUR-4604) EUREX EURATOM-CNEN AGREEMENT ANNUAL REPORT 1969. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 26 Oct 1970. 22p. (In Italian). Dep. NTIS (U. S. Sales Only). EUR Lit. 500.

Activities in the fifth year under the Eurex Project since the signing of the CEEA-CNEN Agreement for the construction, operation, and industrial use of the Eurex plant are described. Information is included on the planning and construction of the plant; cold experiments; laboratory and pilot-scale tests and experiments for the purpose of starting up the plant; and operation of the fuel element swimming pool. (auth)

23726 (EUR-4608) SLIDE RULE FOR THE EVALUATION OF GEOCHEMICAL AND MINERAL SURVEY DATA. De Wolde, H. I.; Brinck, J. W. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 10 Nov 1970. 20p. Dep. NTIS (U. S. Sales Only). EUR F.Fr. 5.60.

The geochemical slide rule was developed as a simple calculating aid to the economic geologist and mineral explorer for the statistic evaluation of geochemical- and mineral survey data in terms of mineral resources and possible ore reserves. The rather complicated formulas which describe the theory on the log-normal distribution of minerals in the earth's crust can be numerically applied easily by the slide rule. (auth)

23727 (N-70-32747) POTASSIUM TURBOALTERNATOR PRELIMINARY DESIGN STUDY. VOLUME 2. REFINEMENT OF SELECTED TURBOALTERNATOR LAYOUT, PHASE 2. Schnetzer, E. (ed.) (General Electric Co., Cincinnati, Ohio). Jun 1970. Contract NAS3-10933. 378p. (NASA-CR-1587; GESP-297(Vol.2)). NTIS.

The preliminary design, selected from the Phase 1 study, of a potassium turboalternator for space was established as part of a nuclear Rankine cycle space power system of 2 MW(t) reactor power. The rating is 660 kVA, 450 kW(e), 480 V(L-N), and 1600 Hz. Potassium is the 2-phase turbine working fluid. Liquid potassium is the lubricant and the coolant. The turbine is all refractory metal. Design life is 3 years with growth potential to 5 years. Performance and design feasibility were established. Remaining problems are turbine erosion, long term creep behavior of turbine rotor materials, and the alternator bore seal. (auth) (STAR)

23728 (STI/DOC-10/122) AIR FILTERS FOR USE AT NUCLEAR FACILITIES. A Guidebook. Technical Reports Series No. 122. Linder, P. (International Atomic Energy Agency, Vienna (Austria)). 1970. 83p. IAEA $3.00.

A guidebook prepared primarily for IAEA member states for use in developing nuclear programs is presented. The primary emphasis is on filter data and information. Information is also included on ventilation systems. (J.R.D.)

23729 DOMESTIC PRODUCTION OF GLOVES FOR PLUTONIUM HANDLING. Shimanuki, Ryoichi (Japan Atomic Energy Research Inst., Tokyo); Kitani, Tsuneo. Genshiryoku Kogyo; 16: No. 5, 51-4(May 1970). (In Japanese).

Because of their radioactive and toxic nature transuranic elements such as plutonium and thorium must be handled in dry boxes. The dry box gloves play an important role in the safe handling of these materials. Gloves for this application have mostly been imported, but in this case there are disadvantages including the poor fitting to the Japanese physique and the deterioration with age. In an effort to produce them domestically, therefore, the trial production of the gloves was made at JAERI. The technology to produce even better quality gloves than imported ones was developed. The following aspects of dry box gloves are described: requirements for the gloves, including the material; the status of glove manufacture in France and the United States; the domestic production of neoprene and latex gloves employing the rubber-dough dipping method; and the future problems, dealing with mass production and gas tightness. (Japan)

23730 UT-AEC AGRICULTURE RESEARCH LABORATORY VARIABLE DOSE RATE FACILITY. Cheka, J. S. (Oak Ridge National Lab., Tenn.); Robinson, E. M.; Wade, Leo; Gramly, W. A. Health Phys.; 20: 339-43(Mar 1971).

The design, construction and calibration of a whole-body irradiation facility with flexible dose-rate capability for the evaluation of dose rate effects in large domestic animals is described. The design criteria used were: it should deliver, reproducibly to ±5%, 1 to 50 R/min over a 2 yr period. To insure the latter, the initial maximum exposure rate should be ~70R/min, the energy spectrum, in air, should be uniform throughout the exposure rate range, it should provide uniform exposure to a minimum of five adult cattle, it should provide for maximum safety in all phases of operation, it should provide an automatic control system. (UK)

23731 DEVELOPMENT AND TESTING OF AN EXPERIMENTAL ELECTROMAGNETIC PUMP FOR LIQUID STEEL. Jones, T. S. (Allegheny Lundlum Industries, Inc., Brackenridge, Pa.); Ramachandran, S.; Yerrick, W. B.; Gahan, J. W. Met. Trans.; 2: 433-6(Feb 1971).

An electromagnetic pump for liquid steel was built and subjected to laboratory testing. This pump was a flat linear induction pump whose flow channel was approximately $\frac{5}{8}$ by 12 in. in cross section by 51 in. long. This pump was successfully operated with molten stainless steel in a demonstration in which a pressure development of about 9 psi was achieved. Possible areas of application of electromagnetic pumping to steelmaking operations and directions of further development are considered. (auth)

Heat Transfer and Fluid Flow

Refer also to abstracts 23724, 24594, and 25971.

23732 (AEC-tr-7184) CALCULATION OF THE HYDRODYNAMIC CHARACTERISTICS OF CLUSTERS OF RODS. Subbotin, V. I.; Ushakov, P. A. Translation of Russian report. 25p. Dep. NTIS.

The methods of calculating the average hydrodynamic values during laminar and isothermal flow of liquids in clusters of rods are examined. The methodology of calculating flow in clusters of rods with large values of S/d is analyzed in detail. The most acceptable methodology in the given case is that based on Rothfuss' perfected method for calculation of flow in annular channels.

Formulas are given for calculation of the coefficients of friction in rod clusters. (auth)

23733 (AERE-R-6564) HEAT TRANSFER TO GAS FLOWING IN CONVERGENT ANNULAR PASSAGES. Kennedy, T. D. A. (Atomic Energy Research Establishment, Harwell (England)). Dec 1970. 52p. Dep. NTIS (U. S. Sales Only). UK 8s.

Theoretical and experimental work on heat transfer to helium gas flowing in convergent annular passages is described. The work is aimed at finding an effective method of predicting heat transfer for the design of in-pile experiments which aim at achieving constant surface temperature along the heated inner surface of the annulus by increasing the heat transfer coefficient progressively along the flow channel. A small computer program is described, which predicts conditions for ensuring laminar flow, and then predicts heat transfer coefficients for laminar flow conditions. The predicted heat transfer coefficients are compared with experimental results, and show good agreement at lower flows [$(Re)_{d_e} < 1.2 \times 10^4$]. Transition to turbulent flow seems to occur sooner than predicted, but this is considered to be caused by the 180° bend at the entrance to the annulus. (auth) (UK)

23734 (CONF-681209-4) HEAT TRANSFER TO MERCURY FLOWING IN-LINE THROUGH AN UNBAFFLED ROD BUNDLE: EXPERIMENTAL STUDY OF THE EFFECT OF ROD DISPLACEMENT. I. Hlavac, P. J.; Dwyer, O. E.; Helfant, M. A. (Brookhaven National Lab., Upton, N. Y.). 14 Aug 1968. 16p. Dep. NTIS.

From Winter annual meeting of the American Society of Mechanical Engineers; New York (1 Dec 1968).

In an experimental study of heat transfer to mercury flowing in-line through an unbaffled rod bundle, it was found that displacement of a rod from its symmetrical position can result in a large reduction in its average heat transfer coefficient. This reduction increases exponentially with the amount of displacement. For a given direction and amount of displacement, the reduction is little affected by variations in cladding thickness and conductivity but is affected considerably by flow rate. Not only does the displaced rod suffer a reduction in its own average heat transfer coefficient, but so do those toward which it is displaced. At the same time, the average coefficients of the rods from which it is displaced remain about the same. Thus, the overall average coefficient of the group of affected rods goes down when a single rod is displaced. The experiments were carried out under thermal boundary conditions approximating those of uniform wall heat flux in all directions. (auth)

23735 (KFKI-70-35-RPT) BIOT: A 3-DIMENSIONAL STEADY-STATE AND TRANSIENT HEAT CONDUCTION CODE. Toth, I.; Szabados, L.; Grillo, P. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). 30 Nov 1970. 19p. Dep. NTIS (U. S. Sales Only).

BIOT is a code written for ICL-1905 computers in FORTRAN language for the calculation of problems concerned with heat conduction in three-dimensional steady-state systems. Although a modified version of GHT code is involved in the calculation of a temperature field, the well-known disadvantage of the large amount of input data required by such a code is overcome in BIOT by the use of a preparatory program. Since a nuclear code is not involved, this allows a greater flexibility in the choice of heat source. Material properties and film coefficients are considered as functions of position without temperature and time dependence. The maximum number of mesh points is 700. (auth)

Isotope Technology

Refer also to abstracts 23713, 23885, 23893, 23901, 23907, 23919, 24592, and 26051.

23736 (AE-410, pp 63-82) ISOTOPIC BATTERY IN THE μW-RANGE. (Aktiebolaget Atomenergi, Studsvik (Sweden)).

From General Physics Section progress report, fiscal year 1969-70.

Experiments with isotopic, mainly tritium, batteries are described. Commercially available solar cells and surface-barrier detectors were used for α and β voltaic conversion. Lifetime and efficiency were determined. Experiments in direct collection of β particles from commercially available tritium sources were carried out and a tritium battery was developed. A combination of a standard tritium TiT_2 source with an Al collector and 0.5 μm SiO isolator has given 10^{-9} W/cm² at optimum load resulting in 6.5 V output voltage and a conversion efficiency of 0.166%. (Sweden)

23737 (INP-717) DETERMINATION OF SOME KINEMATIC FLOW CHARACTERISTICS OF WATER/SAND STOWING MIXTURE BY MEANS OF RADIOMETRIC MEASURING METHODS. Korbel, K.; Owsiak, T.; Krasowski, R.; Michalik, A.; Nizegorodcew, A.; Przewlocki, K.; Szmal, Wl. (Institute of Nuclear Physics, Krakow (Poland)). 1970. 18p. Dep. NTIS (U. S. Sales Only).

The performance and results of radiometric measurements of the kinematic flow characteristics of the multifractional water/sand mixture in pipelines are presented. In the measurements, the gamma absorption method for density gaging and the radiotracer technique for the selective determination of the flow velocities of particular grain-fraction were applied. (auth)

23738 (MLM-1805) STABLE ISOTOPE SALES: MOUND LABORATORY CUSTOMER AND SHIPMENT SUMMARIES, FY 1970. Stringham, W. S. (comp.) (Mound Lab., Miamisburg, Ohio). 19 Mar 1971. Contract AT(33-1)-Gen-53. 27p. Dep. NTIS.

A listing of Mound Laboratory's stable isotope sales of noble gases and carbon-13 for Fiscal Year 1970 is given. Purchasers are listed alphabetically and are divided into domestic and foreign groups. A cross-reference index, by location (U. S., state), is included for domestic customers. Cross-referenced listings, by isotope purchased, are included for all customers. (auth)

23739 (ORNL-4663) ORNL ISOTOPIC POWER FUELS QUARTERLY REPORT FOR PERIOD ENDING DECEMBER 31, 1970. Lamb, Eugene (Oak Ridge National Lab., Tenn.). Feb 1971. Contract W-7405-eng-26. 18p. Dep. NTIS.

On the basis of metallographic examination of compatibility test specimens W-26% Re seems to be the best container material for $^{244}Cm_2O_3$. Samples of hot-pressed $^{244}Cm_2O_3$ pellets (two sizes) and $^{244}Cm_2O_3$ powder are being exposed to 600 ml of air-saturated distilled water and 600 ml of seawater to measure the rate of solution. The initial rates in distilled water were calculated to be 1.4×10^{-4} and 2.3×10^{-4} mg/cm² · hr for the large and small pellets, respectively; in seawater the rates were 4.1×10^{-4} and 8.0×10^{-4} mg/cm · hr. The compound $^{244}CmIr_3$ and alloys of this compound with iridium have been proposed as isotopic power fuels. A preliminary study on a method of preparation and the determination of relevant properties of this fuel is underway. Calculations to determine the neutron shielding offered by 4 and 7 in. of LiH around the outside of the MHW generator have been made. Eighteen $^{170}Tm_2O_3$ pellets and compatibility test metal disks have been encapsulated. Equipment for measuring the vapor pressure of $Tm_2O_3-Yb_2O_3$ mixtures has been assembled. New cladding materials are being developed for containment of radioisotopes in power systems for use in space. The addition of 1% Hf to the Pt-5% Mo alloy results in improved tensile strength at both room and elevated temperatures without impairing the ductility. Alloys in the Pt-Rh-W and Pt-Rh-Re systems and modifications of those that contain additions of Hf, Zr, or Ti are also being investigated. The properties being evaluated include fabricability, melting point, air oxidation, compatibility, mechanical properties, and weldability. (auth)

23740 (ORNL-IIC-31(Vols.1-7)) PERMUTED ISOTOPES AND RADIATION TECHNOLOGY INDEXES (PIRTI), 1962-1969. Raaen, Helen P.; Baker, P. S.; Lafferty, Robert H. Jr.; Klein, Ann S.; Helton, Linda P. (eds.) (Oak Ridge National Lab., Tenn.). Mar 1971. Contract W-7405-eng-26. 282p. Dep. NTIS.

The index is cumulative and is prepared to facilitate retrieval of information from Isotopes and Radiation Technology. Information is included on keyword index, bibliographic index, personal author index, corporate authors, and suggestions concerning use of the index. (J.R.D.)

23741 (SC-RR-70-881) THEORETICAL EXPLANATION OF A VERTICAL FLIGHT FREE-FALL BALLISTIC CHART. Stone, G. W. (Sandia Labs., Albuquerque, N. Mex.). Dec 1970. 14p. Dep. NTIS.

A theoretical analysis of the translational motion of objects dropped from rest at altitude is performed to explain the inherent characteristics of a ballistic chart that was developed by empirical means. (auth)

23742 (TID-4066) DIVISION OF ISOTOPES DEVELOPMENT RESEARCH AND DEVELOPMENT PROJECTS: 1970. Progress Reports on Sponsored Work. (Division of Isotopes Development (AEC), Washington, D. C.). Feb 1971. 161p. Dep. NTIS.

Summaries of current research and development projects being supported by the USAEC's Division of Isotopes Development are reported. The summaries are reported under the following major technical program areas and objectives: radioisotope production and materials, thermal applications, environmental and ocean sciences, radiation analysis and control, process radiation, and radiation preservation of foods. Each summary includes the name

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and address of the investigator(s), objective of the work, progress and results, plan for next period, reports published (if any), and estimated date of final report. Author, Corporate Author, and Subject Indexes are included. (R.C.K.)

23743 URANIUM ENRICHMENT AND THE STAND OF JAPAN. Kikuchi, Seishi (Inst. of Physical and Chemical Research, Yamato, Japan). Karyoku Hatsuden; 21: 922-6(Aug 1970). (In Japanese).

Power generation by nuclear energy is increasing rapidly throughout the world. Reactors employed are primarily those using slightly enriched uranium, such as BWR and PWR. First, the situation of nuclear power generation and the supply capacity of enriched uranium by the U. S. are reviewed. To cope with the future demand of such fuel, three alternatives taken by Japan are discussed: use of natural uranium instead of enriched, dependence on the U. S.'s supply, and the construction of enrichment plants in Japan by introducing foreign technology. This latter alternative appears to be desirable. To make possible the introduction of foreign technology, Japan must develop her own technology to a certain extent for actual production. The general scope of uranium enrichment depends upon the practical use of fast breeder reactors. The effort to be made by Japan for her own uranium enrichment is considered in detail: the course to be taken until about 1980; the decision of centrifugal or gaseous diffusion techniques, in which the respective features are taken into consideration; and the necessity for the immediate transition from basic research to the study of industrial production. (Japan)

23744 GAMMA RAY LASER HAVING A LOW TEMPERATURE CLOSED RESONATING CAVITY. Piekenbrock, Lawrence J.; Tibbals, Edward Camp Jr. (to Alexander Dawson, Inc.). U. S. Patent 3,557,370. 19 Jan 1971. Filed 14 Feb 1968.

A gamma ray laser device, wherein a coherent beam of gamma radiation is generated through stimulation of gamma transitions in excited atomic nuclei in a biologically, shielded and low temperature closed resonating cavity is described. The atomic nuclei are externally excited by high-energy electrons. (Official Gazette)

23745 ISOTOPIC SEPARATION OF URANIUM AND RELATED ECONOMICS. Nucl. Eng. Int.; 16: 74-7(Jan-Feb 1971).

A summary is presented of the meeting held in Paris Nov. 1970. The gaseous diffusion system was favoured by France whereas the advantages of the centrifuge project were put forward by the UK and Germany. The arguments for the latter are summarized in some detail. Briefer reference is made to Swedish computer studies on optimization of cascades for both diffusion and centrifuge systems, of the progress made on the nozzle process in Germany, and of a U. S. paper in which aspects of the USAEC pricing policy for toll enrichment are explained. (UK)

23746 INDIUM GENERATOR. Gruverman, Irwin J.; Rocco, Gregory G. (to New England Nuclear Corp.). U. S. Patent 3,561,932. 9 Feb 1971. Filed 26 Jan 1967.

A generator of a daughter radionuclide, particularly radioactive indium (^{113m}In), and a method of loading a particulate substrate of the generator with a parent radionuclide are described. The daughter radionuclide, which results from the radioactive decay of its parent, is selectively extracted from the substrate by a mineral acid solvent (eluant), such as hydrochloric acid (HCl) at a concentration less than one-tenth normal (0.1 N). (Official Gazette)

23747 PHOTOCHEMICAL ISOTOPE SEPARATION DEVICE. Morand, J.-P.; Nief, G. (to Commissariat a l'Energie Atomique). French Patent 1,596,540. 22 Jun 1970. Filed 1 Aug 1968. (In French).

This invention concerns a photochemical system for separating an isotope from a mixture of Hg isotopes. It includes a monoisotopic discharge lamp mounted in an airtight chamber containing a continuous flow of liquid which has little oxidizing action and does not react with the element. The fluid is fed into the top part of the chamber, flows by gravity around the lamp and is evacuated at the bottom. The system also includes a coil to which a high-frequency current is applied for excitation of the light source, and a circuit connected to the chamber for the introduction and evacuation of a gas mixture containing this element and a product reacting with the isotope. The liquid flows through a circuit outside the chamber, fitted with a flow regulation reservoir, a pump and a cooling system. (France)

23748 HELICAL MULTISTAGE ISOTOPE SEPARATOR. Veach, A. M.; Bell, W. A.; Johnson, R. L.; Love, L. O. (Oak Ridge National Lab., Tenn.). Nucl. Instrum. Methods; 92: 325-8(1971).

Numerous instruments have been constructed to achieve mass separation by electromagnetic means, the most productive being the calutron type. The sector instrument, used at many laboratories to supply smaller quantities of material, has been designed for economical construction, low beam current, and the achievement of a more nearly perfect mass separation. An engineering approach to improving enrichment capabilities in sector-type isotope separation involves the construction of multistage instruments. Extension of this concept has resulted in a multistage calutron-type separator, constructed for use in an existing calutron tank. The ion source accelerates the beam across magnetic field lines at a slight angle to produce a helical path having a reference radius of 24 in. Beam components focus at the 180° position where all isotopes are collectible except one which is allowed to continue its helical trajectory. This selected isotopic beam is allowed to pass through an additional 360° of travel before being collected at the 540° position. Ion output to the 540° collector has reached a maximum of 750 μA, and the isotopic purity of ^{125}Te from the third separation run is 98.95% compared with 95% resulting from best performance in a 48-in.-radius calutron. (auth)

Materials Testing

Refer also to abstracts 23737, 23902, 23926, 24561, 24671, and 25605.

23749 (LIB/Trans-342) PRINCIPLES AND PROCEDURES FOR COLOR RADIOGRAPHY. Richter, H. U.; Linke, D. Translated by J. Brueckner (Australian Atomic Energy Commission), from Technik (Berlin); 21: 424-30(1966). 19p. Dep. NTIS (U. S. Sales Only).

A review of the tested and suggested methods of color radiography is given as an evaluation of the international literature. Processes are considered as either direct or indirect, and variations on films (including single and multi-film methods), exposure, development and treatment are outlined. Associated aspects such as transformation to color television and use of special photographic material are also explained. (101 refs.) (Australia)

23750 THEORETICAL MAGNITUDE OF RELAXATION CREEP IN A MATERIAL SUBJECTED TO A FINITE TOTAL STRAIN RATE. Gittus, J. H. (United Kingdom Atomic Energy Authority, Springfields, Eng.). Phil. Mag.; 23: 393-8(Feb 1971).

Creep relaxation and creep under neutron irradiation and at constant stress are particular examples of the general class of behavior exhibited by materials subjected to elastic-plus-plastic straining. The theory of such systems is further developed for a specimen subjected to variable restraints, loads and thermal strains including the cases where the thermal strains vary cyclically. (auth) (UK)

23751 INSTANTANEOUS ANALYSIS IN METALLURGY BY EMPLOYING PROMPT (n,γ) PROCESSES. Higatsberger, M. J. Radex Rundsch.; No. 3, 182-90(Jul 1970). (In German).

In a search for finding an automatic process-control for the manufacture of O-blown steel, a comparison is made between three methods of nondestructive analysis: the conventional activation analysis, the photo-activation analysis, and the prompt (n,γ) reaction. It is shown that the (n,γ) reaction of both fast and epithermal neutrons opens up new possibilities for continuous steel analysis. A detailed investigation was made into the delayed γ lines appearing on bombarding Fe samples with 14-MeV neutrons. By employing Ge–Li detectors in the relevant spectrometer systems it was shown that with only 10^6 reactor neutrons/cm^3 Mn amounting to 1% could be determined to within a 10% accuracy. (Metals Abstr.)

Radioactive Material Handling

Refer also to abstracts 23697, 23704, 23725, 23764, 23765, and 24192.

23752 (BNWL-1541) WASTE SOLIDIFICATION PROGRAM, VOLUME 7. PHOSPHATE GLASS SOLIDIFICATION PERFORMANCE DURING FINAL RADIOACTIVE TESTS IN WASTE SOLIDIFICATION ENGINEERING PROTOTYPES. McElroy, J. L.; Hartley, J. N.; Schwab, M. R.; Thompson, R. J.; Drager, R. F. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jan 1971. Contract AT(45-1)-1830. 238p. Dep. NTIS.

Testing of high-level radioactive waste solidification by the phosphate glass process has been successfully completed. More than 12 million curies of radionuclides were processed and collected in 6- and 8-inch diameter containers during the final five engineering-scale demonstration runs in WSEP. Radioactivity processed ranged from 1 to 3 million curies during the five runs. A maximum self-generating heat-rate of 11.9 kilowatts (198 W/

liter) and 9.3 kilowatts (317 W/liter) was attained in 8-inch and 6-inch diameter pots, respectively. The solidified waste within a full 8-inch diameter pot represented 0.84 tons of PW-4m waste representative of power reactor fuel (irradiated at 45,000 MWd/ton at a power level of 30 MW/ton) and 0.36 tons for a waste representative of LMFBR core fuel irradiated to 100,000 MWd/ton at 200 MW/ton. High level aqueous radioactive waste was processed at overall rates of 13 to 26 liters/hr. The equivalent processing rates ranged from 0.20 to 0.58 tons/day of original fuel. From 5 to 9% of the total ruthenium fed to the solidifier was volatilized and/or entrained from the solidifier; entrainment of nonvolatiles varied from 0.04 to 0.07%. Volatilized and entrained material from the denitrator was further treated in the WSEP auxiliary process equipment, while the volatilized and entrained material from the melter was collected in a separate condensate receiver. The WSEP auxiliary process equipment consisting of an evaporator, an acid fractionator, mist eliminator, filters, condensers, and caustic scrubber reduced the radionuclide concentration in the stack gas to well below 10CFR20 release limits. The radionuclide content in the final aqueous liquid effluent was decontaminated by a factor of 10^7 to 10^8 for nonvolatiles and 10^5 to 10^6 for radioruthenium to concentrations that initial studies indicate are acceptable for recycle to a fuel reprocessing plant or for low-level treatment processes. The phosphate glass product caused no significant changes to the solidified waste containers or no pressure increases within the containers after they were capped and welded. (auth)

23753 (GULF-RT-10511) APPLICATION OF PHOTOINDUCED REACTIONS TO NUCLEAR MATERIALS SAFEGUARDS PROBLEMS. Quarterly Progress Report, October 1, 1970–December 31, 1970. Bramblett, R. L.; Costello, D. G.; Ginaven, R. O.; McMillan, J. I.; Rundquist, D. E.; Trimble, G. D.; Naliboff, Y. D. (Gulf Radiation Technology, San Diego, Calif.). 10 Feb 1971. Contract AT(04-3)-167. 45p. Dep. NTIS.

The development and application of techniques and equipment for the nondestructive measurement of nuclear materials in the various forms that can be encountered in the fuel cycle are described. The major emphasis was on field testing the Gulf Atomic Mobile Assay System (GAMAS). The field test at the Atomics International Santa Susana storage site was completed in October. Some modifications were made to make the trailer more roadworthy and to allow GAMAS to travel in all states without a special permit. These modifications and other improvements are discussed. GAMAS was used to assay 5-gallon drums containing silicon carbide with enriched uranium. The results and a brief discussion of these measurements are given. The general details of the present software package for the Hewlett Packard 2116 B computer which is used to accumulate and analyze data are discussed. The software is continually evolving as more experience is gained in the utilization of GAMAS; however, the basic logic in the data accumulation and analysis programs has proven quite satisfactory and is not expected to change significantly. What remains to be done is to have the computer control some of the basic measurement parameters such as the initial position, rotation, and vertical motion of the barrel scanner. The interface to these controls has been built and tested. The control programs will be incorporated in the near future into the software package. The control of some of the fundamental parameters of the Linac is also a contemplated use of the computer. Present experience and future possibilities indicate that the reliability and practicability of a mobile assay laboratory will depend to a large extent on the speed and automatic control that can be gained by the proper utilization of a small computer. The major features of the Isotopic Source Assay System are discussed along with the present status of ISAS-III. This system is being used in the measurements at Rocky Flats. Passive measurements on the ^{240}Pu content and direct active measurements on the ^{239}Pu will be made on the 1-gallon sized containers. (auth)

23754 (KFK-1108) THE QUALITATIVE SAFEGUARD MEASURES IN THE SPHERE OF CONTROL OF FISSIONABLE MATERIAL. Hagen, A.; Nentwich, D.; Otto, H. E.; Gupta, D. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Oct 1970. 30p. (In German). Dep. NTIS (U. S. Sales Only).

Qualitative safeguard measures are categorized. At the same time the efficiency of these measures is compared with that of the quantitative measures. Furthermore, some typical examples of qualitative measures which appear promising in their potential of development are described. The fields of application for these measures in the nuclear fuel cycle, as seen today, are indicated. (tr-auth)

23755 (LA-4605) NUCLEAR SAFEGUARDS RESEARCH AND DEVELOPMENT PROGRAM STATUS REPORT, SEPTEMBER–DECEMBER 1970. (Los Alamos Scientific Lab., N. Mex.). Jan 1971. Contract W-7405-eng-36. 41p. Dep. NTIS.

Research and development results are reported on neutron interrogation and nondestructive assay of fissionable materials, passive neutron and gamma radiation uses, detector and instrumentation development, analytical and computational methods, mobile nondestructive assay laboratories, and Van de Graaff accelerator facility modification. (J.R.D.)

23756 (UJV-2396.Ch.) FIXATION OF CONCENTRATED HIGH-ACTIVITY WASTES FROM IRRADIATED FUEL TREATMENT LABORATORY EXTRACTION LINE. Napravnik, J. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). [nd]. 10p. (In Czech). NTIS (U. S. Sales Only).

Pilot-scale equipment was designed for the fixation of medium-activity and eventually high-activity wastes in bitumen. A mixture of aqueous bituminous emulsion with concentrates of medium or high activity will be heated to a temperature of 140°C so that the water will evaporate. The molten bitumen will be poured into suitable molds and the condensed water will be analyzed for radioactivity and discharged as low-activity waste. The equipment, comprising a 5 liter storage tank for the aqueous bitumen emulsion, a 3 liter storage tank for the active concentrates, a 9 liter electrically-heated evaporator unit equipped with a horseshoe stirrer, a drop separator, a water vapor cooler, a storage tank for the condensate, an air filter filled with activated carbon, and molds for bitumen transport, will be installed in a hot chamber and will operate in succession to the extraction line. The equipment will be operated discontinuously. (INIS)

23757 RADIOACTIVE WASTES. Wheatley, B. M. (Central Electricity Generating Board, Berkeley, Eng.). Proc. Soc. Anal. Chem.: 8: 25-7(Jan 1971).

It would be wrong to suggest that the safe disposal of radioactive waste is easy or cheap. However, the problems are understood better than those of any other disposal requirement. The major arisings occur in a relatively few large establishments where there is a fund of scientific and technological skill with adequate financial backing. Even now the necessary technology is being developed to continue safe working in the year 2000 A.D., when the power reactor program is expected to be much larger. (auth) (UK)

Vacuum Engineering

Refer also to abstracts 24856 and 25556.

23758 PROCEEDINGS OF THE 17th NATIONAL SYMPOSIUM OF THE AMERICAN VACUUM SOCIETY, WASHINGTON, D. C., 20–23 OCTOBER 1970. Whetten, N. R. (ed.). J. Vac. Sci. Technol.; 8: 1-393(Jan-Feb 1971). (CONF-701011).

Separate abstracts were prepared for 13 papers of the 120 papers and abstracts included. The remaining 107 articles were either abstracts of papers or were not within the scope of NSA. (W.H.K.)

For abstracts of individual papers see: 23759, 23760, 24542, 24571, 24653, 24844, 25034–25036, 25211, 25237, 25594, and 25595.

23759 ULTRAHIGH VACUUM JOINTS USING COMPRESSION AND WELDED SEALING OF ALUMINUM TO BERYLLIUM. Parsons, Richard E. (Univ. of California, Livermore). J. Vac. Sci. Technol.; 8: 341-3(Jan-Feb 1971).

From 17th National Meeting of the American Vacuum Society, Washington, D. C. See CONF-701011.

A 1-in.-dia beryllium window of a thickness not to exceed 0.005 in. was developed. The window was electrically conductive to its mount and supported atmospheric pressure on one side while maintaining a low helium leak rate. An ultrahigh vacuum and pressure seal was built utilizing a beryllium to stainless steel joint. A leak-tight configuration was maintained at 150-psi pressure and 200°C. A beryllium 0.0005-in.-thick vacuum barrier 0.875-in. dia was developed to operate at 200°C and to hold a differential pressure of 10^{-3} torr. The seal was accomplished by containing the beryllium foil in a nested gasket and clamping this "sandwich" in a modified commercial seal configuration. (auth)

23760 MILLITORR PUMPDOWN ANOMALY RELATIONSHIPS WITH LARGE PIPE CHAMBER DESIGN TRADEOFFS. Schalla, Clarence A. (Lockheed Missiles and Space Co., Sunnyvale, Calif.). J. Vac. Sci. Technol.; 8: 344-7(Jan-Feb 1971).

From 17th National Meeting of the American Vacuum Society, Washington, D. C. See CONF-701011.

Pumpdown predictability of large pipe-type vacuum chambers was improved through design tradeoff reevaluation based on check-

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out anomaly analysis. Truncated-cone pipe chambers up to 2,000 ft long and 200,000 ft^3 in volume, which served as underground nuclear effects testbeds, were analyzed. Inconsistencies in evacuations to a base pressure of 1 mtorr are identified with the sorbing time variable of the chamber wall and experiment support materials. Variations in pressure levels along the pipe chambers are shown related to configuration factors and to design tradeoffs on allowable inleakage from concrete shrouding, sand stemming, and tunnel atmospheres. Cascading graphs innovated for tradeoffs include two recently derived flow conductance equations. (auth)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstract 23755.

General Detectors and Monitors

Refer also to abstracts 23876, 23905, 23928, 23932, 24075, 24193, 24230, 24257–24261, 24426, 25224, 25627, 25720, 25998, and 26014.

23761 (AD-711286) RADIATION-INDUCED ACOUSTIC CAVITATION IN A SCINTILLATION LIQUID. Zavadil, Stephen W. (United States Naval Academy, Annapolis, Md.). 15 May 1970. 62p. (USNA-TSPR-7). NTIS.

A possible time correlation between the incidence of radiation in a liquid upon which a sound field was impressed and the subsequent cavitation event was investigated. A scintillating liquid enclosed in a cavitation cell was considered ideal for such a study. An ionizing particle produced a scintillation event, and if of sufficient energy, triggered a cavitation event. Since both events are observable, a time correlation could be established between them. Such a time correlation was not established. Several problems of major importance were encountered; however, none of them are necessarily insurmountable. Suggestions are made for improvements that would allow this study to be carried to a fruitful conclusion. (auth) (USGRDR)

23762 (AECL-3786) CHARGE TRAPPING IN SEMICONDUCTOR DETECTORS: A THEORETICAL APPROACH. Blair, J. M.; McMath, T. A. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Dec 1970. 20p. Dep. NTIS (U. S. Sales Only). AECL $0.50.

A probability theory approach has been employed to study the effects of the statistical variation in induced charge in a semiconductor detector whose charge collection properties are well characterized by the carrier mean free drift lengths λ_e and λ_h. It is shown that the resulting spread in pulse amplitude cannot account for the broadening of the full energy peaks observed in detectors which show charge trapping effects. (auth)

23763 (BARC-527) SURFACE BARRIER DETECTORS FROM P-TYPE Si. Chaudhry, Ramesh; Srikantiah, R. V. (Bhabha Atomic Research Centre, Bombay (India)). 1971. 23p. Dep. NTIS (U. S. Sales Only).

Surface barrier detectors have been fabricated from P-type Si in the resistivity range from 700 to 12000 ohms-cm. Detectors have been made with energy resolutions of 25 keV for 5.48 MeV ^{241}Am alpha particles with a sensitive area of 80 mm^2 and a depletion depth of 150 microns. Depletion depths of 300 microns with a sensitive area of 250 mm^2 have been obtained with 72 keV energy resolution for 5.48 MeV alphas. Some detectors have been made with evaporated guardring structure which is found to improve the energy resolution. Leakage currents and their variation with time have been studied for encapsulated and unencapsulated detectors. Details of the method of fabrication and results are given. Variation of capacitance of the detectors with reverse bias has been studied and results confirm the abrupt junction formation. (auth)

23764 (BHO-66-2) PLUTONIUM PASSIVE ASSAY FACILITY PLANT INSTRUMENTATION PROGRAM. Second Quarterly Progress Report, July–September 1970. Brooks, W.; Rosh, D. (United Nuclear Corp., Elmsford, N. Y. Research and Engineering Center). 30 Nov 1970. Contract AT(30-2)-66. 5p. Dep. NTIS.

All equipment and materials for both neutron- and gamma-detection systems, except the multichannel analyzer, were received. Bids for the construction of the counting shield were obtained. (R.W.R.)

23765 (BHO-69-2) PLANT INSTRUMENTATION PROGRAM. Second Quarterly Report, July–September 1970. (Nuclear Materials and Equipment Corp., Apollo, Pa.). Contract AT(30-1)-69. 26p. Dep. NTIS.

Passive gamma assay of plutonium scrap was undertaken. The density of the material in the sample counted has a considerable effect on the count rate. Accurate attenuation-measurement methods are required to correct the above results. A method was developed for the nondestructive gamma assay of possibly contaminated exhaust filters. The amount of Pu in glove-box-generated waste contained in 55-gallon drums was investigated; it was found that accurate package or drum assay requires that the packages be completely filled with waste. Some work was also done on neutron-coincidence counting of Pu scrap. (R.W.R.)

23766 (BNL-15643) WORK ON GAMMA COMPENSATED AND HIGH-PURITY GERMANIUM RADIATION DETECTORS. Summary of Report, January 1–December 31, 1970. Llacer, J. (Brookhaven National Lab., Upton, N. Y.). 76p. Dep. NTIS.

Research on the compensation of n-type germanium by gamma radiation is reported. Hall effect measurements and their interpretation; the process of making p^+ and n^+ contacts on medium and high purity germanium; measurements on completed γ-compensated and high-purity devices; and a mathematical model of a junction with deep acceptor levels are discussed. (W.H.K.)

23767 (BNWL-CC-2354) OPTIMIZATION OF CERIUM-ACTIVATED GLASS ALPHA SENSORS. Koski, O. H. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). 15 Dec 1969. 21p. Dep. NTIS.

The beta sensitivity of cerium-activated Vycor alpha sensors can be greatly improved through control of the cerium-activated-zone geometry. The alpha sensors as manufactured are disk shaped with the activated zone diffused to a depth from ten to thirty mils and roughly parallel to the surface. Optimized beta discrimination is achieved by grinding the surface of the disk so as to leave a diffusion depth of about one mil. However, a gradual rather than stepwise diffusion zone boundary, as well as convex, concave or saddle-shaped diffusion zones, may make the acceptance of a deeper diffusion depth necessary. The minimum practical depth is on the order of $1\frac{1}{2}$ mils for about half the commercial sensors tested and $2\frac{1}{2}$ mil or more for the remainder. Further improvement in beta discrimination is obtained by limiting the area as well as depth of the activated domain. Photonproductive domains consisting of spots two mils in diameter and five mils apart and one mil deep are observed to be near optimum. (auth)

23768 (CEA-N-1425) NEUTRON MEASUREMENT DEVICE WITH A WIDE DYNAMIC RANGE, WITH COMBINATION OF PULSE AND FLUCTUATION TECHNIQUES. Plaige, Y.; Buisson, J.; Garau, J.; Lyscar, J. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 12 Jan 1971. 15p. (In French). Dep. NTIS (U. S. Sales Only).

Pulse instrumentation is now widely used in reactor control. Fluctuation instrumentation is currently being industrially developed and will be used in the near future. Both types of instrumentation use the same detectors, that is fission chambers. In consequence an instrument with a wide dynamic range adapted to both techniques was studied. A theoretical analysis of the problem is presented and the practical developments and results obtained from tests with a pile discussed. It seems possible that in the near future a control instrumentation functioning over 10 decades will be available. (auth) (France)

23769 (JINR-P13-5628) METHOD OF PRECISE DETERMINATION OF PARTICLE COORDINATES IN PROPORTIONAL CHAMBER. Biryukov, V. A.; Zinov, V. G.; Konin, A. D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1971. 8p. (In Russian). Dep. NTIS (U. S. Sales Only).

It is shown that in proportional multiwire chambers with the potentiometric readout, the accuracy of determining the coordinates of charged particles that are oblique to the wire plane is considerably higher than for particles that are transverse. This is due to the fact that obliquely falling particles are traveling through the working volumes of several wires, while the current of each wire is divided into two parts and is summed at the ends of the attenuator with the weight proportional to the wire number. For example, if the obliquely falling particle flies through the working volumes of three wires, the accuracy of determination of its coordinates may be ±0.05 of the interval between the separate wires. (auth)

23770 (MIT-952-7, pp 183-210) ALPHA SCINTILLATION COUNTING AND URANIUM MINE DOSIMETRY. (Massachusetts Inst. of Tech., Cambridge. Dept. of Physics).

In Radium and mesothorium poisoning and dosimetry and instrumentation techniques in applied radioactivity.

The development and operation of the Instant Working Level Meter (IWLM) for determining airborne radon daughters in uranium mines are discussed. The IWLM consists of an air sampler, a surface-barrier alpha detector, and a plastic scintillation beta detector. Calibration and testing of the IWLM are described, and equations for calculating the working level are presented. Also, the development and testing of a thermoluminescent dosimeter for alpha monitoring for uranium miners are discussed. (W.H.K.)

23771 (NP-18684) GEOMETRY EFFECTS IN A GAMMA JUNCTION RADIATION DETECTOR. Note No. 90. (Ministere des Armees, Arcueil (France). Laboratoire Central de l'Armement). Nov 1968. 34p. (In French). Dep. NTIS (U. S. Sales Only).

An attempt was made to determine the optimum dimensions compatible with the industrial manufacturing of Ge junction detectors of parallelepiped form for detecting 15 to 150 keV x rays. The energy loss by the radiation in the bulk of Ge was evaluated. The process used for the numerical calculation was a simulation accurately reproducing the physical phenomena occurring during the detection and based on a Monte-Carlo method. The advantages of voluminous detectors in detecting the maximum number of photons are indicated. (auth)

23772 (ORNL-TM-3165) DEVELOPMENT OF TWO SYSTEMS FOR MONITORING ALPHA-EMITTING PARTICULATES IN RADIOACTIVE GAS DISPOSAL STACKS. Shipp, R. L. Jr. (Oak Ridge National Lab., Tenn.). 29 Dec 1970. 33p. Dep. NTIS.

A modified alpha constant air monitor that is used for monitoring alpha-emitting particulates in the effluent of the 3039 stack at ORNL is not designed to ignore alpha activity due to a naturally occurring radon and thoron background and will actuate an unwanted alarm when the background count rate rises to a preset level. Two new monitoring systems were developed as possible replacements for this monitor. One of these systems, a radon-rejecting air monitor, makes use of alpha energy-spectrum data to reject radon and thoron background. This monitor has been field tested for 3 years. An alpha energy spectrometer can be added to this system to enable identification of the alpha contaminants. The second system, a cyclic spectral air monitor, displays the alpha contamination as alpha energy spectra with good resolution. This display enables rapid identification of the contaminants, and operating personnel can determine whether the alpha activity is due to radon–thoron background or has been released from a nuclear or radiochemical processing facility discharging its off-gases to the stack. Results from laboratory mock-ups of the two new monitors are presented along with a discussion of problems experienced during a field test of the radon-rejecting air monitor. Features of all three monitors are compared. (auth)

23773 (ORNL-TM-3260) MULTIPLE-WINDOW SPECTROMETRY FOR ^{67}Ga. Ross, D. A.; McClain, W. J.; East, J. K.; Bell, P. R. (Oak Ridge National Lab., Tenn.). Mar 1971. Contract W-7405-eng-26. 14p. Dep. NTIS.

The element gallium has been shown to concentrate favorably in a number of malignant human and animal tumors; and its importance in the scanning field is, therefore, obvious. From the standpoint of favorable half-life and tolerable radiation hazard, ^{67}Ga is the isotope of choice. This nuclide, however, presents problems to the detecting instruments, since it emits four main gamma lines, of which the most prominent, at 93 keV, is subject to severe scattering and interference from those above it. Successively higher-energy photons have decreasing interference but are less and less intense. When this nuclide is used, therefore, it is especially important to choose spectrometer settings with care, so that misinformation contributed by scattered photons will be kept to a minimum. This problem bothers both the moving-head scanners and the cameras. The relative merits of various energy-band arrangements are discussed; these include some that bracket more than one spectral peak and others in which each peak has a spectrometer window of its own. The settings indicated as favorable were applied to the ORNL research scanner, the target object being a phantom so designed that the interfering effects of scattered radiation were prominent. It is found advisable to place a spectrometer window over each of the four major peaks. The prominence of the 93-keV peak tempts one to use it alone (especially with a camera), but this will almost invariably result in a poor-quality scan. Illustrative scans are presented to indicate the advantages of using properly selected energy bands. (auth)

23774 (ORNL-TM-3347) ENERGY CALIBRATION OF A PROTON-RECOIL PROPORTIONAL COUNTER. Morgan, G. L.; Love, T. A.; Straker, E. A.; Freestone, R. M. Jr.; Burgart, C. E. (Oak Ridge National Lab., Tenn.). 15 Mar 1971. 22p. Dep. NTIS.

Three methods for calibration of proton-recoil proportional counters have been investigated. These are the ^{14}N(n,p)^{14}C reaction, an internally mounted alpha-particle source, and observations of resonances in a neutron spectrum. Calibrations based on each method were compared and found to be consistent to within 2%. The variation of the gas amplification as a function of counter voltage was measured and was found to be in good agreement with the formula of Diethorn. (auth)

23775 (RD/B/N-1863) METHODS OF GAMMA RAY SPECTROMETRY APPLICABLE TO SHIELDING MEASUREMENTS. Fraser, A. J. (Central Electricity Generating Board, Bristol (England). Berkeley Nuclear Labs.). Dec 1970. 19p. (RPC/Sh/P-(70)8). Dep. NTIS (U. S. Sales Only).

A gamma ray spectrometer is required for use around nuclear power stations in areas of high flux. A satisfactory detector must be suitable for site work, i.e., have known resolution and accuracy and be neutron-insensitive. From a range of detectors investigated, an organic liquid scintillator was selected and initial measurements indicate that it will function in gamma fields which give doses of about 2 R.hr^{-1}. (auth) (UK)

23776 (RFP-1466) METHOD TO DETERMINE FAST AND THERMAL NEUTRON FLUXES BY FOIL ACTIVATION ANALYSIS. Murri, Richard L.; Vasilik, Dennis G. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). 12 Mar 1971. Contract AT(29-1)-1106. 12p. Dep. NTIS.

A general method of foil activation analysis for measuring neutron fluxes is presented with a complete derivation of the mathematical expressions used. Although the method is not new, descriptions of the theory, experimental procedures, and the constants and parameters used in the analysis are widely scattered in the literature. This report compiles this information for easy reference. Detailed examples using copper foil activation for measuring fast neutron fluxes and indium foil activation measuring thermal neutron fluxes are given. (auth)

23777 (RT/FI-(70)23) PREPARATION AND CALIBRATION OF THIN DEPOSITS OF FISSILE MATERIALS. Balducci, G.; Biancifiori, M. A.; Martini, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 29 Apr 1970. 38p. Dep. NTIS (U. S. Sales Only).

Techniques of thin film deposition are widely employed to prepare detectors for neutron flux measurements. Methods adopted for the preparation of thin films of fissile materials are described. They are based on the vacuum or controlled atmosphere evaporation and on the electrochemical deposition process. Methods to calibrate layer thicknesses are also described. (auth)

23778 (UCRL-73001) PRINCIPLES OF OPERATION OF SEMICONDUCTOR DETECTORS. Armantrout, Guy A. (California Univ., Livermore. Lawrence Radiation Lab.). 10 Feb 1971. 50p. (CONF-710204-2). Dep. NTIS.

From Symposium on the Role of Semiconductor Detectors in the Future of Nuclear Medicine, Chicago, Ill.

The fundamental theory of semiconductor detectors is presented. Topics include structure of an atom, effects of radiation on an atom, radiation detection using a gas, solids as radiation-detection media, optimization considerations for a p-n junction detector, and practical p-n junction devices. (W.H.K.)

23779 INVESTIGATION INTO VISUALIZATION PROBLEMS IN RADIOISOTOPE SCANNING. Vauramo, E. (Tampere Central Hospital, Finland). Acta Acad. Abo., Ser. B; 30: No. 5, 1-47 (1970).

Setting out from the clinical fact that radioisotope scanning does not show all those details which are later revealed in an autopsy, a new phantom and measuring method for investigating the image properties of scanners and gamma-ray cameras and for calculating their figures of merit has been developed. By means of measurements and theoretical calculations it is shown that the method is more practicable than those previously used. By carrying out precision measurements one can obtain indications for the construction of better collimators. The results are also clinically significant for the earlier diagnosis of diseases. (auth) (Finland)

23780 IMPROVED RATIO CIRCUIT FOR POSITION SENSITIVE DETECTOR AND ITS USES. Nakamoto, Shunsuke (Chubu Inst. of Tech., Kasugai, Japan); Sakisaka, Masakatsu. Radioisotopes (Tokyo); 20: 1-6(Jan 1971).

An improved ratio circuit for the surface-barrier position sensitive detector uses has been fabricated by applying the pulse sampling technique. The ratio magnitude of the input X and E signals has been converted to a square pulse of width $\tau(\propto X/E)$, which is changed to the pulse amplitude to be analysed. The final E and X/E pulses of 2 μs duration are simultaneously put out. The present X/E range is from 0.1 to 1.0 and its linearity is about 1%. The illustrative characteristics using ^{210}Po–α, ^{241}Am–α particles and accelerated protons are presented. (auth)

23781 HIGH SELECTIVITY ELECTROMAGNETIC RADIATION DETECTING DEVICES. Hall, Robert N.; Baertsch, Richard D.; Richardson, John R. (to General Electric Co.). U. S. Patent 3,560,812. 2 Feb 1971. Filed 5 Jul 1968.

A high selectivity solid-state radiation detector having a Schottky

barrier-type junction is fabricated by depositing a thin silver film of prescribed thickness atop a semiconductor crystal to form a sharp silver-to-semiconductor interface. The film allows a narrow band of the electromagnetic radiation incident thereon to pass therethrough into the semiconductor. Such radiation band is at an energy which is greater than the energy gap of the semiconductor and is thereby strongly absorbed, producing electron-hole pairs within the space-charge region of the barrier and giving rise to a photoelectromotive force or photoconductivity that peaks at an energy of radiation greater than the energy gap. If the radiation transmitted by the silver film is of energy less than the band gap of the semiconductor it is only weakly absorbed in the semiconductor, and therefore produces negligible response. By varying the film thickness, the selectivity and peak sensitivity may be further controlled. (auth)

23782 LABYRINTH LIGHT SEAL SYSTEM FOR A LIQUID SCINTILLATION COUNTING APPARATUS SAMPLE CHANGING MECHANISM. Olson, Robert E.; Ellyn, Glen; Smith, Roy E. (to Packard Instrument Co., Inc.). U. S. Patent 3,553,454. 5 Jan 1971. Filed 7 Nov 1967.

A light seal for a liquid scintillation counting apparatus sample changing mechanism is described in which a continuous sample conveyor feeding the counting chamber of the apparatus is disposed in a serpentine path within a light-tight tunnel enclosing a load–unload station. (auth)

23783 AXIALLY ALIGNED GAMMA RAY-NEUTRON DETECTOR. Peters, Charles W. (to Secretary of the Navy). U. S. Patent 3,566,118. 23 Feb 1971. Filed 14 Nov 1968.

A neutron and gamma ray detector including in combination one detector that detects gamma rays and another detector that detects neutrons in the presence of a large flux of gamma rays is described. The two detectors are combined in such a manner that the scintillator material of the gamma detector becomes the moderator material of the neutron detector. (auth)

23784 DEVICE FOR REMOTE CHECKING OF OPERATION AND SENSITIVITY OF RADIATION MONITORS. Nemirovsky, Boris Vladimirovich; Korotin, Boris Andreevich; Shatalin, Boris Sergeevich; Mitjunin, Vladimir Alexandrovich. British Patent 1,219,635. 20 Jan 1971. Filed 7 Mar 1968.

A small, light device of low power consumption for checking remotely the operation and sensitivity of radiation monitors by means of controlled irradiation is described. The controlled irradiation can consist of a radioactive source disposed so as to be angular displacement by means of a remotely controlled electromagnetic device. Alternatively the source can be fixed while a shield with an aperture can move in a similar manner to the source in the previous example. (UK)

23785 METHOD AND APPARATUS FOR PROCESSING INFORMATION. (to Gesellschaft fuer Kernforschung mbH). British Patent 1,221,004. 3 Feb 1971. Priority date 21 Nov 1967, Germany.

A method of processing information from a plurality of detectors such as proportional counters or spark chambers operating in the proportional region is described. The detector capacities are used as electrostatic storage means which are discharged by means of an electron beam. (W.H.K.)

23786 ELECTROMETRIC AMPLIFIER FOR MEASUREMENTS WITH SELF-POWERED DETECTORS. Azzoni, A. (Centro Informazione Studi Esperienze, Milan). Energ. Nucl. (Milan); 17: 733-5(Dec 1970).

A low-current amplifier fitting the dynamic characteristics of β and γ self-powered detectors is described. The schematic diagram for the amplifier and its response to step-function input signals are given. (R.W.R.)

23787 PLASTIC TRACK-TYPE DETECTOR FOR SLOW NEUTRONS HAVING THE NEUTRON CONVERSION SUBSTANCE UNIFORMLY DISPERSED THEREIN. Schultz, Warner W.; Jones, Stanley L. (to United States Atomic Energy Commission). U. S. Patent 3,548,191. 15 Dec 1970. Filed 13 Mar 1969.

This invention is a track-type detector for slow neutrons (0.01 eV to 0.1 MeV) comprising a substrate on which a track detector plastic is deposited, the plastic containing a uniform disperson of one of the following compounds: Tetraphenyl boron, hexamethyl borazine, lithium ricinoleate, or carborane. (auth)

23788 RADIATION DETECTION USING ORGANIC SEMICONDUCTORS. McGuire, Stephen Alfred. Madison, Wis.; Univ. of Wisconsin (1970). 109p. University Microfilms Order No. 70-20,856.

Thesis.

The properties of organic semiconductors required for radiation detection are reviewed. The electrical properties of 3-μ thick, vacuum-deposited films of phthalocyanine and the merocyanine dye, 5-[-3-ethyl benzthiazolylidene ethylidene](-3-ethyl-rhodanine) (EBER), are investigated. Charge carrier production in phthalocyanine and EBER is primarily an extrinsic process greatly enhanced by the presence of oxygen. It does not involve a two-exciton process in the production of charge carriers and cannot be the result of transitions below 1.4 eV. The motion of carriers is severely limited by trapping. The lifetime of carriers is several milliseconds, including some time spent in very shallow traps and the mean free path is <300μ. Organic materials, doped so the quantum efficiency for charge carrier production is large, can be used to detect pulses from ionizing radiation if they are used with fields high enough for injection of carriers from the electrodes to fill most of the traps. (TSS) (Diss. Abstr. Int., B)

23789 TRANSACTIONS OF THE FIRST SKANDINAVIAN CONFERENCE ON THIN FILM COATING BY SPUTTERING TECHNOLOGY AND APPLICATIONS, 21, 22, AND 23 APRIL 1970, HELSINGOER, DENMARK. van Sabsay, Eugen (ed.). Taeby, Sweden: Isotronic AB (1970). 191p. (CONF-700432).

A separate abstract was prepared for one of the eight papers presented. The remaining seven papers were not within the scope of NSA. (W.H.K.)

For abstracts of individual papers see: 23790.

23790 SURFACE BARRIER RADIATION DETECTORS AND CHANNEL MULTIPLIER STRUCTURES BY SPUTTERING. Tove, P. A.; Berg, S.; Andersson, L. P.; Hyder, A. (Uppsala Univ.). pp E1-16 of Transactions of the First Skandinavian Conference on Thin Film Coating by Sputtering Technology and Applications, 21, 22, and 23 April 1970, Helsingoer, Denmark. /von Sabsay, Eugen (ed.). Taeby, Sweden: Isotronic AB (1970).

From 1st Conference on Thin Film Coating by Sputtering Technology and Applications, Helsinger, Denmark. See CONF-700432.

Electrical properties of a surface barrier detector prepared using sputtering techniques were studied. Use of sputtering techniques was shown to be critical with respect to sputtering parameters. Good detectors were obtained when low sputtering power was used. The energy resolution obtained when the diodes were used for detection of α-particles was similar to evaporated diodes. Remaining surface damage was measured. Sputtering technology was used to manufacture channel multipliers. The gain was measured as a function of applied voltage when using the multipliers for detection of single electrons. Values of resolution were found to compare favorably with those given for commercial channel multipliers of cylindrical structure. No afterpulses resulting from ionic feedback from the output were observed. (Sweden)

23791 PULSE TYPE DOUBLE CONSTRUCTION IONIZATION CHAMBER. Kurosawa, Ryuhei (Waseda Univ., Tokyo). Waseda Daigaku Rikogaku Kenkyusho Hokoku; No. 47, 15-26(May 1970). (In Japanese).

A new method is presented for determining the airborne concentration of Po-218, Pb-214 and Bi-214 in uranium mine atmospheres. The method employs a tandem construction pulse type electron ionization chamber technique to distinguish the alpha particles of Po-214 from those of Po-218 and Po-214. A source side window of the system is covered with a 5 μm thin rubber film. Therefore, both the alpha particles of Po-218 and Po-214 can be detected by a source side chamber with a similar counting efficiency, but the opposite side detects only alpha particles of Po-214 owing to the absorbing action of the counting gas and window material of the side chamber. The counting efficiencies of the source side and opposite side chamber are estimated to be 11.7% and 2.75% for alpha particles of Po-218 and Po-214, and 39.5% and 34.9% for that of Po-218 and Po-214, respectively. The individual air concentrations of Po-218, Pb-214 and Bi-214 can be determined by matrix algebra involving only two equations and two unknowns. The experimental comparisons are presented. (auth) (Japan)

23792 PROPORTIONAL COUNTER FOR DETERMINATION OF PRIMARY PARTICLE CONCENTRATION OF RADON DAUGHTERS. Kurosawa, Ryuhei (Waseda Univ., Tokyo). Waseda Daigaku Rikogaku Kenkyusho Hokoku; No. 47, 1-14(May 1970). (In Japanese).

The instrument employs a gas flow proportional alpha counting technique to measure the alpha activities of primary particles attached to the inner surface of the outer electrode owing to their high diffusion velocity. In order to provide the large value of gas multiplication in spite of a low applied voltage, the fine wire electode (50 μm dia. stainless steel) is inserted into a cylindrical outer electrode (17 mm inner dia. and 390 mm long brass tube).

According to the experimental results considered with theoretical modification, the counting efficiencies for the alpha particles of Po-218 and Po-214 are estimated as 43.2% and 43.5% respectively, under standardized counting conditions. The detectable limit of the proposed instrument is evaluated as 1.3×10^{-9} μCi/cm³ for the concentration of Po-218 primary particle based on statistical considerations. (auth) (Japan)

23793 MEASUREMENT OF ATMOSPHERIC CONCENTRATION OF DECAY PRODUCTS OF RADON. Lasseur, C. (to Commissariat a l'Energie Atomique). Canadian Patent 859,834. 29 Dec 1970. Priority date 13 Apr 1967, France.

An apparatus is described for the continuous measurement of the concentration in the atmosphere of short-lived solid elements resulting from the decay of radon, namely, radium A, radium B, radium C, and radium C^1, by measuring the activity of each of the above elements. The apparatus included a filter strip, a system for moving the strip, a sampling tube traversed by the strip, the tube being open at one end and connected at the other end to pumping device through the intermediary of an electrovalve, and an alpha-radiation detector. Also, a beta-radiation detector was placed in oppositely-facing relation to the alpha detector, one detector being above the strip and the other beneath. Both detectors are placed at a predetermined distance from the sampling tube. There is a cyclic control assembly for delivering on the one hand the pulse which opens the electrovalve and defines the beginning of a sampling stage, and on the other hand for initiating, in particular, the operation of the strip-moving system after a given sampling time. (Canada)

23794 DETERMINING RADIATION TRACKS IN SHEET MATERIAL AND APPARATUS THEREFOR. Cross, W. G.; Tommasino, L. (to Atomic Energy of Canada Ltd.). Canadian Patent 859,262. 22 Dec 1970.

Fission fragment tracks produced in sheet mica and other electrical insulating materials of radiation dosimeters are counted by leaching the tracks so that they provide electrical discharge paths through the sheet. Aluminum foil is placed on top of the sheet and a voltage is applied between an electrode covering the underside of the sheet and the foil to sequentially puncture the foil by electrical discharges through the tracks. The discharges are then counted. (Canada)

23795 EXPERIMENT OF ENERGY SPECTROSCOPY OF GAMMA RAYS USING ORGANIC SCINTILLATOR. Nishikawa, Kiyoshi (Konan Univ., Kobe, Japan); Ishiketa, Tadashi. Mem. Konan Univ., Sci. Ser.; No. 12, 23-32(Nov 1969).

A probability function of the pulse height distribution for the estimation of the gamma energy from the spectrum from an organic scintillator is presented and discussed. (TSS) (Japan)

23796 FABRICATION METHOD OF SEMICONDUCTOR DETECTOR FOR NUCLEAR RADIATION DETECTION. 1. SILICON SURFACE BARRIER DETECTOR. Yamamoto, Hisao; Sakai, Kazuyoshi; Wakuta, Yoshihisa; Sonoda, Masateru (Kyushu Univ., Fukuoka). Kyushu Daigaku Kogaku Shuho; 42: 803-10(Jan 1970). (In Japanese).

An n-type silicon crystal (specific resistance: 2,000 Ω-cm, carrier life time: 480 μs, etch pit density: 3×10^3/cm², crystal-face direction: 1-1-1, dimensions: 21 mmø, 250 μm thick) was used. The crystal, after cleaning in methanol, was etched for 5 minutes in CP4 solution to the thickness of 120 μm and an oxide layer was formed by leaving it in the air for 24 hours. Acrylic acid resin was used for the mounting frame, and polyurethane varnish for glueing. Gold was deposited by the method of vacuum evaporation on one side of the silicon wafer to form a surface barrier, and aluminum was deposited on the other side to form an ohmic contact. The leakage current and capacity measured were 0.4 μA and 220 pF respectively for the detection bias voltage of 30V. The electronic system comprises a low noise preamplifier, linear amplifier, low level discriminator, 400 CH PHA, bias power supply, and Hg pulser. Using this detector, an energy resolution power of 47 keV (FWHM) was obtained for the α-rays of Th C'. (Japan)

23797 LOW BACKGROUND COUNTER FOR THE MEASUREMENT OF ULTRA LOW RADIOACTIVE MATERIALS. Matsuda, Hideki; Umemoto, Shunji (Kyushu Univ., Fukuoka). Mem. Fac. Sci., Kyushu Univ., Ser. C; 7: No. 1, 75-83(Mar 1970).

In order to determine the low radioactivity of trace radioactive nuclides, a β-β anti coincidence and a β-γ coincidence counting system were constructed. It is composed of a 2π GM counter (center counter), a shielding GM counter (guard counter) and a γ-ray detector. The 2π GM counter is a square-shaped detector which has two windows and is made to have high counting efficiency by holding the samples close to the detector. The shielding GM counter is made up of two different-sized oxygen-free copper pipes. As a γ-ray detector, a 2.5" ϕ × 2" NaI(Tl) crystal was used, and an EMI 6255B photomultiplier was used. The center counter and the γ-ray detector are set in the guard counter and all of these are shielded with oxygen-free copper sheets and lead bricks. The β-β anticoincidence and β-γ coincidence counting systems have sufficiently low background, and are applicable to cosmochemical studies. (Japan)

23798 PHYSICAL PARAMETERS OF 3" AND 5" SCANNER SYSTEMS. Tautz, M.; Ertl S. (Staedtisches Klinikum, Berlin). Radiol. Diagn.; 11: 639-46(1970). (In German).

The parameters of collimator-detector systems were determined by means of a line source. Two collimators were available for the 5"-probe and 5 collimators for the 3" probe. Spatial resolving power, sensitivity of depth and plane, and dependence on source-collimator distance are discussed. An opinion on the observed emigration of the sensitivity maximum of the systems is given. The value of isoresponse-pictures for practice is verified. (auth)

23799 REACTOR NEUTRON DOSIMETRY IN IRRADIATION OF MATERIALS. Moteff, John (General Electric Co., Cincinnati). pp 201-45 of Radiation Dosimetry. Vol. III. /Attix, Frank H. (ed.). New York; Academic Press Inc. (1969).

Reactor neutron radiation characteristics (e.g., the energy spectrum) are treated first. This is followed by a discussion of the characteristics of radioactivation-type detectors, which have proved to be of primary importance for measuring neutron flux density and energy spectra. Methods of determining neutron spectra using such detectors are then discussed; these include resonance reactions, the effective-threshold technique, polygonal and polynomial methods, orthonormal expansions, and iterative methods. Finally, the relation between the neutron spectrum and damage in metals is discussed. (55 references) (R.W.R.)

23800 MEASURING THE NATURAL RADIOACTIVITY OF THE FREE ATMOSPHERE. Chkhenkeli, Sh. M.; Okroashvili, G. G.; Khundzhua, T. G. (Inst. of Geophysics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 60: 573-5(Dec 1970). (In Russian).

A description is given of an aircraft-mounted instrument for measuring the natural radioactivity of the free atmosphere due to short-lived decay products of radon. The instrument is presented in the form of a block diagram. (auth)

23801 PULSES USED FOR PARTICLE DETECTION. Blanc, D.; Peyre-Lavigne, A.; Segur, P.; Petel, M. (Toulouse Univ.). Onde Elec.; 51: 29-34(1 Jan 1971). (In French).

The principal characteristics of two different detectors, both operating with high-frequency pulses, are described: a surface-barrier detector for x rays in the 500-eV to 10-keV range and a spark detector operating in the open air and suitable for detecting β radiation from tritium. (auth) (France)

23802 FIXED GEOMETRY TEST SOURCE ASSEMBLY FOR GAS FLOW PROPORTIONAL COUNTERS. Robinson, Richard L. Jr. (to U. S. Navy). U. S. Patent 3,538,327. 3 Nov 1970. Filed 29 Nov 1967.

An assembly that enables a radioactive test source to be exposed for detection of a radioactive gas or for low-energy counting in a gas-flow proportional counter without altering any operating parameters of the test chamber, such as volume, pressure, temperature, composition of the filling, and surface area within the chamber, is described. (auth)

23803 COUNTING SYSTEM FOR USE WITH GAS FLOW PROPORTIONAL COUNTER. Mizuho, Mitsuru (Japan Atomic Energy Research Inst., Tokai). Nippon Genshiryoku Gakkaishi; 13: No. 1, 7-13(1971). (In Japanese).

A counting system for use with gas flow proportional counters has been examined and the advantages are discussed of a specially developed pre-amplifier of current-to-voltage conversion type. The system proposed, which embodies a conventional voltage amplifier as main amplifier, retains the advantages of the current mode signals from a flow counter. The present method has the further convenience of using a commonly adopted general purpose voltage amplifier with pole/zero cancellation, a base-line restorer, and other nuclear instrument modules (NIM). Good plateau characteristics were obtained for both α- and β-particles from RaDEF source with double and triple differentiation pulse shaping. Furthermore, a slope of less than 0.1%/100V was obtained with ^{32}P source at a counting rate of 2,000 cps. A noise level of 0.03 μA peak-to-peak was realized without particular selection of transistors permitting detection of 2 to 3 ion pairs of ionization. (auth)

23804 AUTORADIOGRAPHY WITH THE ELECTRON MICROSCOPE: DIFFERENTIAL SENSITIVITY OF PHOTOGRAPHIC

EMULSIONS FOR TRITIUM. Huelser, Dieter F.; Rajewsky, Manfred F. (Max-Planck-Institut fuer Virusforschung, Tuebingen, Ger.). Z. Naturforsch.; 26b: 133-6(Feb 1971). (In German).

The sensitivity of the photographic emulsion is an important factor in the resolution of autoradiographs at the electron microscopic level. In a number of recent publications, single hit processes have been considered sufficient for the production of developable latent images by tritium electrons. However, since the absorbed energy required for latent image formation in AgBr crystals of commercially available emulsions is of the order of 800 eV, only low energy tritium electrons (up to 3 keV) will produce latent images by single hit processes in small AgBr crystals of about 400 Å diameter. In emulsions with larger AgBr crystals (about 1000 Å diameter), electrons with an energy of up to about 6 keV can be registered by single hit processes. Evidently, latent image formation may also result from multiple hits by electrons of higher energy. Since the energy absorption required for latent image formation is constant, the sensitivity of photographic emulsions must be considered proportional to the diameter of the respective AgBr crystals, unless methods become available for specific sensitization of emulsions with small AgBr crystals. (auth)

23805 ELEMENTY SKHEM YADERNOGO PRIBOROSTROENIYA. (Design of Nuclear Instruments). Gorn, L. S.; Matveev, V. V.; Khazanov, B. I.; Shifrin, A. V. Moscow; Atomizdat (1970). 376p.

A brief review is given of problems in manufacturing apparatus for measuring ionizing radiation. Certain characteristics of transistors and semiconductor diodes and pulsed amplifiers are covered in the first three chapters. Pulse normalizers, schemes for selection and conversion of signals, dc amplifiers, computer design, pulse generators, logical and code elements and the basic schemes for the construction of models for nuclear instruments are described in the following seven chapters. (230 references) (R.V.J.)

23806 THEORETICAL MODEL FOR THE MIGRATION OF ENERGY FROM THE PARTICLE TRACK IN AN INORGANIC SCINTILLATOR. West, J. B. (Borough Polytechnic, London). J. Phys., B (London); 3: 1692-1703(Dec 1970).

An attempt is made to explain the variation in the scintillation efficiency of unactivated NaI crystals at low temperature as the specific ionization of the incident radiation varies between and 1 and 25 MeV $cm^2 g^{-1}$. The theory presented indicates that the variation of luminescent output from pure NaI with temperature is to be associated with the temperature dependent probability of radiative exciton decay, but the theory shows that the exciton formation probability, which the experimental results indicate is also temperature dependent, should be taken into account. Finally, the theory is applied with some success to data for an activated inorganic scintillator used at room temperature. (auth) (UK)

23807 GAS-FILLED IONIZATION COUNTERS. Perelman, Simon Meerovich; Petrenko, Evgraf Efremovich; Prager, Isaak Aronovich; Timofeeev, Alexandr Andrianovich; Tolmachev, Anatoly Filippovich (to Moskovsky Zavod Elektrovakuumnykh Priborov). British Patent 1,223,819. 3 Mar 1971. Filed 15 Jan 1970.

A self-calibrating counter is described that is provided with a performance checking system comprising an auxiliary gas discharge gap together with a radioactive source of predetermined activity located in the auxiliary gap so that its radiation induces a gas discharge solely in this auxiliary gap. The cathode and one of the electrodes in the checking system preferably have openings relatively positioned so that the radiation from the auxiliary gap passes through these openings into the main gap and induces a gas discharge therein. A marked improvement in the accuracy and reliability of measurements is claimed. (UK)

23808 SPURIOUS PULSES IN Ar–CH_4 FILLED PROPORTIONAL COUNTERS. Campion, P. J.; Kingham, M. W. J. (National Physical Lab., Teddington, Eng.). Int. J. Appl. Radiat. Isotop.; 22: 55-65(Feb 1971).

The time distributions of spurious pulses in proportional counters filled with 90% argon and 10% methane were examined. For many of the experimental conditions investigated most of the spurious pulses were found to be associated with Geiger discharges and the distributions showed a broad peak at a time which corresponded very roughly with the positive ion transit time. However no value could be assigned to the positive ion mobility since the Geiger discharge mechanism in these counters is evidently more complex than is normally supposed. An upper limit for the detection of spurious pulses at the centre of the plateau (for ^{55}Fe x rays) was estimated to be 1×10^{-4} spurious pulse per genuine pulse. (auth) (UK)

23809 MULTIDIMENSIONAL ANALYSIS OF NUCLEAR REACTION PRODUCTS BY MEANS OF ONE DETECTOR. Zazulin, V. S.; Mikhaleva, T. N.; Niyakii, S. F.; Chuprunov, D. L.; Dem'yanova, A. S. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 11: 599-605(Nov-Dec 1970). (In Russian).

A description is given of a multidimensional method for analysis of charged particles produced by nuclear reactions. The particles are detected by a scintillation detector CsI(Tl) + PEM-35. The particle identification is based on the different shape of the current pulse. A multidimensional 4096-channel (128 × 32) analyzer with the initial pulse amplitude at the inlet X and the pulse amplitude after ~1.2 μsec at the inlet Y was used as a recording device. Results of the simultaneous recordings of protons, deuteron and α-particle spectra obtained in the presence of γ-background are presented. The low energy threshold of separately recorded α-particles in the (d,α) reaction was 3.5 MeV. (tr-auth)

23810 SEMICONDUCTOR RADIATION DETECTORS IN THE RESEARCH SATELLITE AZUR. Glasow, Peter (Siemens Aktiengesellschaft, Erlangen, Ger.). Siemens Rev.; 38: 12-14 (Jan 1971).

Satellite-borne semiconductor telescope counters for the measurement of protons at 20 to 80 MeV and electrons above 1.5 MeV are described. Characteristics of the surface-barrier and lithium-drifted dE/dx detectors are discussed. (W.H.K.)

23811 USA STANDARD: IMMEDIATE EVACUATION SIGNAL FOR USE IN INDUSTRIAL INSTALLATIONS WHERE RADIATION EXPOSURE MAY OCCUR. ANSI N 2.3 1967. New York; United States of America Standards Institute (1967). 12p. Available from American National Standards Inst., New York.

The characteristics of a standard signal that shall be used for situations requiring immediate, rapid, and complete evacuation are presented. This standard is primarily for use in industrial installations where ionizing radiation exposures may occur, but it may be used for other establishments where immediate evacuation is required to prevent injury. Devices required to activate the signal are briefly discussed, and the design of the signal generator is described. (W.H.K.)

23812 MULTIWIRE DRIFT CHAMBER. A NEW TYPE OF PROPORTIONAL WIRE CHAMBER. Walenta, A. H.; Heintze, J.; Schuerlein, B. (Univ., Heidelberg). Nucl. Instrum. Methods; 92: 373-80(1971).

A new type of proportional wire chamber is described with large wire distances and accurate position determination by drift time measurement. The electronic circuitry required has been considerably reduced while the space resolution has been improved as compared to a conventional proportional wire chamber. The limit for position accuracy seems to be at present $\sigma = 0.2$ mm. The complete system with computer read out has a location accuracy of $\sigma = 0.47$ mm. (auth)

23813 MEASUREMENT OF THE INSTRUMENT RESPONSE FUNCTION IN THE SINGLE PHOTOELECTRON TECHNIQUE. Lami, H.; D'Alessio, J. T.; Zampach, J.; Radicella, R.; Kesque, J. M. (Comision Nacional de Energia Atomica, Buenos Aires). Nucl. Instrum. Methods; 92: 333-7(1971).

Luminescence decay time measurements are generally performed using the single photoelectron technique. In the case of ionizing particle induced luminescence, the determination of the true decay curve requires the precise knowledge of the instrument response function R(t). The measurement of R(t), using the Cherenkov effect is described. (auth)

23814 MEASUREMENT METHODS IN NUCLEAR PHYSICS, GENERATION, AND DETECTION OF RADIATIONS. Koltay, Ede (Nuclear Research Inst., Debrecen, Hungary). Fiz. Szemle; 20: 321-7(Nov 1970). (In Hungarian).

Contemporary experimental techniques employed in nuclear research are reviewed. They are divided into two broad classes, static and dynamic. The former studies deal with nuclei in their ground state that do not participate in decay processes. These techniques cover determination of the mass, radius, charge, momentum, and magnetic moment of the nucleus. The latter methods cover most of the current research in fundamental nuclear physics. They involve determination of the intensity and angular distribution of particles in natural or artificial radioisotopes or in artificially induced nuclear reactions. In radioactive decays α and β particles are encountered; while in nuclear reactions protons, neutrons, deuterons, tritons, and even heavier particles may be emitted. The energy spectrum of the particles is often very complex; in some cases of β decay a continuous spectrum may appear in addition to discrete energy ranges. Accelerators represent an important tool for nuclear research; the use of special targets is examined closely. The detecting methods are similar

for particles generated both by radioactive decay and by nuclear reactions; the various techniques used for the study of charged particles, γ radiation, and neutrons are reviewed. Data processing and pulse-height analysis are also mentioned. (Review article, 26 references to the pertinent Hungarian literature) (TTT)

23815 PULSE-SHAPE DISCRIMINATION IN NUCLEAR PHYSICS. Mathe, Gyorgy (Nuclear Research Inst., Debrecen, Hungary). Fiz. Szemle; 20: 327-32(Nov 1970). (In Hungarian).

Pulse-shape discrimination methods are used for the identification of particles, after piled-up pulses have been filtered out and noise pulses have been eliminated. The rising portion of the pulse delivered by a detector is a function of the time dependence of the physical processes taking place within the detector. The most widely used systems are based on the measurement of the rise-time; "on-line" computer analysis represents the most elegant approach to the solution of the problem. Best results of particle identification on the basis of pulse shape have been obtained with CsI(Tl) scintillators, which may be used equally well for the detection and measurement of γ rays and heavy charged particles; satisfactory results have also been obtained with NaI(Tl), LiI(Eu), KI(Tl), CsBr(Tl), stilbene, anthracene, and certain plastic scintillators above the several-hundred-keV level. Less satisfactory results have been achieved with semiconductor detectors. The pulse-shape discriminators may be used as pile-up detectors. (Review article, no references). (TTT)

23816 WHOLE BODY COUNTER OF THE C. S. N. CASACCIA. Clemente, Gianfelice F. (CNEN–CSN, Casaccia, Italy). G. Fis. Sanit. Prot. Radiaz.; 12: 214-21(1968). (In Italian). (RT/PROT–(69)11).

The construction and engineering characteristics of the Casaccia whole-body counter were examined. The results of the measurement of the internal contamination caused by ^{137}Cs and ^{40}K made on a group of persons of both sexes not professionally exposed are presented. Two cases of internal contamination by ^{131}I and one case of fission-product contamination (^{106}Rh–^{106}Ru, ^{137}Cs, ^{95}Zr) were also examined. (tr-auth)

23817 GEOMETRICAL OPTIMIZATIONS ON APPARATUS FOR MEASURING THE WHOLE-BODY HUMAN RADIOACTIVITY. Fedorov, G. A.; Moiseev, I. F.; Slavyagin, P. D. Med. Radiol.; 16: No. 2, 56-64(Feb 1971). (In Russian).

The effectiveness of spectrometric recording of human gamma-radiation from spot isotropic sources placed in different sites of water-filled human-like phantom during linear scanning, spiral scanning and static scanning with eight crystals was calculated. The dependence between the effectiveness of radiation registration and the localization of isotopes, their energy, size of detectors, geometric conditions of measurements (length, height, radius of scanning, etc.) was analyzed. The authors propose geometric conditions of measurements on clinical spectrometers of human body radiation and outline the parameters of these spectrometers. (auth)

23818 MEASUREMENT OF ^{137}Cs IN BOVINE MUSCLE BY THE CUP METHOD (REPRODUCIBILITY AND SENSITIVITY). Keck, Gertrud; Krocza, W. (Tieraerztliche Hochschule, Vienna. Bundesanstalt fuer Virusseuchenbekaempfung, Vienna). Zentralbl. Veterinaermed., Beih.; No. 11, 116-20(1970). (In German).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

A cup method for measuring ^{137}Cs activity in untreated chopped beef using a 1.75 × 2.0 in. sodium iodide (Tl) crystal is described. The reproducibility of the results, the lower limit of detection, and the sensitivity are given. (auth)

23819 PULSE-HEIGHT DEFECTS FOR HEAVY IONS IN A SILICON SURFACE-BARRIER DETECTOR. Wilkins, B. D.; Fluss, M. J.; Kaufman, S. B.; Gross, C. E.; Steinberg, E. P. (Argonne National Lab., Ill.). Nucl. Instrum. Methods; 92: 381-91(1971).

The pulse-height vs energy response of a surface-barrier detector was measured for the ions He, C, O, Al, S, Ni, Cu, Ag, Au and U. The detector was a heavy-ion type, with high field strength. The ions were obtained by elastically scattering oxygen and sulfur beams on the appropriate targets. The lighter ions (up to sulfur) showed little or no pulse-height defect (PHD). Heavier ions had a significant PHD which increased with increasing energy, and their response curves were non-linear at low energies. The highest energies at which the PHD was measured were: Ni, 58 MeV; Cu, 18 MeV; Ag, 45 MeV; Au, 31 MeV; and U, 26 MeV. The total PHD is described in terms of three contributing parts: a window defect, a nuclear-stopping defect, and a residual defect, which is attributed to charge recombination. The residual defect is shown to be proportional to the difference between the electronic stopping power of the ion in silicon and a constant, in agreement with a simple model of the recombination defect. The constant is the critical value of the stopping power, below which no recombination occurs. Although there is insufficient data on which to base a practical scheme for calibrating detectors for heavy ions at the present time, some features which appear necessary to such a scheme are pointed out. (auth)

23820 EFFECT OF GELATINE ON THE SENSITIVITY OF AgBr CRYSTALS SENSITIZED WITH GOLD. Antanasijevic, R.; Zizic, B. (Institut de Physique, Belgrade). Nucl. Instrum. Methods; 92: 393-5(1971). (In French).

The effect of the precipitation medium (gelatine) on the sensitivity of AgBr crystals and their sensibilization with gold are investigated. It is found that the used gelatines differ in the content of labile sulphur and in their reduction abilities. Both of the mentioned components attenuate the sensitivity of the AgBr crystals. The labile sulphur in the gelatine reduces the concentration of Ag^+ yielding complexes due to which fact the existing concentration of Ag^+ is not sufficient for the formation of stable sensitivity centers in AgBr crystals. For the same reason, the effect of sensibilization with gold is reduced, since the electrochemical exchange of the type $Ag^+ + Au \rightarrow Ag + Au^+$ is reduced, in which case the centers of sensitivity remain at the sublatent level, i.e. AgBr crystals of low sensitivity. The reduction abilities of the gelatine show the same effect. They reduce the Ag^+ and Au^+ in gelatine, rendering the formation of the sensitivity centers in AgBr crystals impossible. According to the mentioned effects the efficiency of the sensibilization can be reached by the use of gelatine with low reduction ability and small amount of labile sulphur. (auth)

23821 MEASUREMENTS OF GAMMA-RAY MASS ATTENUATION COEFFICIENTS OF ORGANIC SCINTILLATORS. Goswami, B.; Chowdhuri, N. (Univ. of North Bengal, Rajarammohunpur, India). Nucl. Instrum. Methods; 92: 433-4(1971).

Preliminary results of gamma-ray attenuation measurements in organic scintillators are given. Total mass attenuation coefficients of a number of the most important organic scintillators for gamma-rays from ^{133}Ba, ^{137}Cs, ^{60}Co and ^{65}Zn have been determined in narrow-beam experiments. Theoretical mass attenuation coefficients are computed by interpolation from the atomic cross-section data of Grodstein. Satisfactory agreement is obtained between the experimentally determined mass attenuation coefficients and the computed values. (auth)

23822 SEMICONDUCTOR RADIATION DETECTOR ARRANGEMENTS. Owen, Richard Bruce; Salmon, Percy George; Awcock, Mervyn Leslie (to United Kingdom Atomic Energy Authority). U. S. Patent 3,548,213. 15 Dec 1970. Priority date 14 Oct 1966, Great Britain.

A semiconductor radiation detector arrangement consists of wafer of n-type silicon with a resistive palladium film on one face to produce a rectifying contact and a gold film on the other face adjacent the initial depletion region. The comparative outputs of amplifiers connected, in effect, to opposite ends of the resistive film provide an indication of the position on the resistive film of an incident charged particle. (auth)

23823 DIRECTIONAL RADIATION DETECTOR. Sinclair, Kenneth F. (to Secretary of the Army). U. S. Patent 3,548,207. 15 Dec 1970. Filed 15 Aug 1969.

Two radiation-responsive devices are positioned adjacent each other with their frontal areas in a common plane. A radiation attenuation element is positioned in the path directly in front of one of the radiation-responsive devices. A differential amplifier and indicating meter receive the outputs of the radiation-responsive devices to provide indications having an amplitude indicating the direction of a source of radiation and a sense, such as polarity, indicating the direction of the source of radiation relative to each of two orthogonally related axes of rotation. (auth)

23824 COUNTER FOR CONDENSIBLE RADIOACTIVE GASES. Bench, Robert W.; Feibush, Arthur M.; Schubauer, Carl T. (to Secretary of the Air Force). U. S. Patent 3,558,883. 26 Jan 1971. Filed 7 Jun 1968.

A system for measuring the radiation emitted from a condensible radioactive gas is described. A specimen of the gas to be measured is introduced into a vacuum-tight environment that also contains the detector for making the measurements. A cold spot is produced in proximity to the detector, and a portion of the gas is condensed thereon and measured in the condensed state. A Dewar flask containing liquid nitrogen or other suitable refrigerant provides the cooling medium for producing the cold spot. Various arrangements of the cold-spot vacuum cham-

ber and the sample chamber in their relation to the Dewar flask are shown. Modifications of the basic idea deal with the location of the sample chamber and the cold-spot vacuum chamber relative to the Dewar flask. (auth)

23825 SMALL BACK-TO-BACK DETECTOR FOR PRECISE COMPARISON OF FISSION AND (n,α) REACTION RATES. Beller, L. S. (Argonne National Lab., Idaho Falls, Idaho). Nucl. Instrum. Methods; 92: 397-401(1971).

A multiple wire proportional counter for simultaneous measurement and comparison of fission and (n,α) reaction rates in identical geometry is described. The active materials are plated in back-to-back geometry in a cylindrical housing less than 1.2 cm in diameter. Provision is made for assessment of gamma-ray sensitivity during in-core reactor measurements and for internal absolute calibration. (auth)

23826 DETECTION OF FAST NEUTRONS BY ETCH-PIT METHOD OF NUCLEAR TRACK REGISTRATION IN PLASTICS. Nishiwaki, Yasushi (Tokyo Inst. of Tech.); Tsuruta, Takao; Yamazaki, Katsuhiko J. Nucl. Sci. Technol. (Tokyo); 8: 162-6 (Mar 1971).

Plastics, such as polycarbonate, cellulose nitrate, and cellulose acetate were irradiated with fast neutrons (2.5, 14 MeV) and a count was made of the number of etch-pits on the surfaces of the irradiated material after etching with suitable chemical reagents. The experiments proved that the number of etch-pits increases with the etching time, and that at least during the early period of etching, a close correlation seems to exist between ΔP the increment in the number of etch-pits per unit area and Δl the increment of thickness of layer removed for a common increment of etching time Δt. In other words, an approximate relation $\Delta P/\Delta l = \rho$ was observed to hold during this early period, ρ being a constant that seems to correspond to the number of etchable damages produced by fast neutron irradiation per unit volume. The value of ρ was found to correspond roughly to the estimated number of recoil carbon and oxygen atoms in a unit volume in the case of polycarbonate which consists of carbon, oxygen and hydrogen. This indicated that the etch-pits observed in polycarbonate might have developed at the sites of radiation damage caused by the recoil carbons and oxygens due to fast neutron irradiation. (auth)

23827 DEVELOPMENT OF MINERAL INSULATED CABLES FOR IN-CORE NEUTRON DETECTORS. McMinn, K. W.; Goodings, A. (Atomic Energy Establishment, Winfrith, Eng.). J. Brit. Nucl. Energy Soc.; 10: 33-40(Jan 1971).

The design and testing of triaxial cables developed for in-core neutron detectors for application in Mark II AGR's and high power fast reactors is described. The cables are for fitting to pulse fission chambers, wide range gamma compensated and uncompensated dc chambers. Summaries are given of the specification and manufacture of the cables. Details are given of electrical tests, resistance and mechanical damage, and long term thermal and irradiation tests. Arrangements for handling and vacuum processing of the cables are described. The design of the cable termination is illustrated. (UK)

23828 APPARATUS FOR THE DETECTION AND/OR ANALYSIS OF NEUTRAL PARTICLES. Wardell, I. R. M. (to Associated Electrical Industries Ltd.). German Patent 1,803,061. 14 Aug 1969. Priority date 16 Oct 1967, Great Britain. (In German).

An apparatus for the detection and/or analysis of neutral particles contained in a particle beam is described. The design and performance of this apparatus are discussed, and the operation is described. (J.F.P.)

23829 ACTIVATION DETECTORS FOR NEUTRONIC MEASUREMENTS. Constantinescu, Florica (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 15: 923-6(1970).

The principal problems of the detectors used for neutron measurements in reactors are presented in this paper. Experimental work was carried out for the production of Lu, Eu, Dy detectors with a 5- to 20-mg/cm^2 concentration. They are used for the study of the rethermalization of neutrons in graphite. Detectors using TiO_2 as dispersing material were devised. These detectors displayed good behavior during high-temperature irradiation and their characteristics are presented. (auth)

23830 DISCRIMINATING DEVELOPMENT OF CHARGED PARTICLE TRACKS IN NUCLEAR EMULSIONS. II. DISCRIMINATING POWER AND ACTIVITY OF NaSCN AND AMIDOL DEVELOPER. Haseganu, D. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 15: 869-79(1970).

The study of the NaSCN and amidol developer properties is continued in order to determine the discriminating power and the activity of this developer. After a general discussion of the two properties, experimental results obtained for energy loss ranging between 0.110 and 0.140 MeV/μ are reported. A relation for the variation of the g parameter with respect to residual range is obtained. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 25629, 25665, 26037, and 26038.

23831 (AAEC/LIB/Bib-270) PROTON-RECOIL COUNTERS FOR THE MEASUREMENT OF FAST NEUTRONS. A Bibliography. Geue, Jean (comp.) ([Australian Atomic Energy Commission Research Establishment, Lucas Heights]). Feb 1971. 14p. Dep. NTIS (U. S. Sales Only).

Eighty nine references are listed, covering the period April 1963 to 1970. Arrangement is alphabetical by author within each year. A reference to an abstract for each article is given. (Australia)

23832 (AAEC/TM-572) LARGE VOLUME, MULTI-ELEMENT Ge(Li) SPECTROMETER. Lawson, E. M.; Tavendale, A. J.; Dawson, A. C. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov 1970. 15p. Dep. NTIS (U. S. Sales Only).

To make use of the good energy resolution of Ge(Li) spectrometers at γ-ray energies of several MeV, the sensitive volume must be increased to beyond 100 cm^3. This volume is generally only attainable by operating several smaller spectrometers in parallel. Three coaxial Ge(Li) detectors were fabricated, assembled in a cryostat and operated in parallel. The spectral performance and relative efficiency of this multi-element spectrometer were investigated for γ-rays of energies between 1 and 10 MeV. High energy γ-rays (5–10 MeV) were obtained by thermalizing neutrons from a Pu–Be source and then absorbing them in materials with high cross sections for radiative capture. The experience gained is summarized and alterations to future multi-element spectrometers are proposed. (auth)

23833 (BMBW-FBK-70-27) TRANSMISSION MOUNTED SILICON SURFACE BARRIER DETECTORS. Andersson-Lindstroem, G.; Fretwurst, E.; Oelert, W. (Hamburg Univ. (West Germany). I. Institut fuer Experimentalphysik). Dec 1970. 27p. (In German). Dep. NTIS (U. S. Sales Only).

A fabrication method for silicon surface-barrier detectors suitable for charged-particle spectroscopy in nuclear physics was developed. The application as transmission-type detectors to be used at lower temperatures in telescopes was taken into special consideration. The fabrication technique and results on the detector performance are presented here. Special investigations on long-term stability and temperature- and vacuum-stability, as well as dependence on material quality and geometry, are included. (auth)

23834 (CEA-N-1381(1)) GAMMA-RAY SPECTRA COMPUTER CODE. PART I. Delor, Michel (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). Sep 1970. 46p. (In French). Dep. NTIS (U. S. Sales Only).

A computer code for automatic analysis of complex gamma ray spectra from multichannel analyzer and a Ge(Li) detector is presented. The method enables the separation of close peaks: doublets, triplets, etc... At the moment this program is limited to calculate the energies and the areas of the significant peaks. (auth)

23835 (CNEN-RT/EL-70-1) THE INTERFACE FOR A TRIPLE AXIS NEUTRON SPECTROMETER ON-LINE CONTROLLED BY PDP-8L. Babiloni, L.; De Agostino, E.; Fillarini, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1970. 21p. (In Italian). NTIS (U. S. Sales Only).

The interface for a PDP-8L computer control of a triple axis neutron spectrometer is described. (auth)

23836 (CNEN-RT/EL-70-2) SOFTWARE FOR A TRIPLE AXIS SPECTROMETER ON-LINE CONTROLLED BY PDP8-L. Babiloni, L.; De Agostino, E.; Fillarini, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1970. 34p. (In Italian). NTIS (U. S. Sales Only).

The software for a PDP8-L controlled triple axis diffractometer is described. A detail description is given of the programs for the data acquisition and the on-line control. (auth)

23837 (EUR-4599) DOCHAP: A FORTRAN IV PROGRAM FOR THE CORRECTION AND CALIBRATION OF NEUTRON INELASTIC SCATTERING DATA. Krebs, K.; Winfield, D. J. (European Atomic Energy Community, Ispra (Italy). Joint Nu-

clear Research Center). 17 Oct 1970. 42p. Dep. NTIS (U. S. Sales Only). EUR F.Fr. 6.65.

This program is used to correct raw data obtained from the Ispra-1 Double Chopper Neutron Spectrometer Facility. Corrections available are for background, air attenuation, detector efficiency and sample thickness. In addition, the data may be normalized with spectra obtained from a vanadium reference specimen. A smoothing routine may also be utilized if the data have low statistical accuracy. The corrected data output is available in either punched, printed or graphical format. (auth)

23838 (NP-18664) ECCENTRICITY EFFECTS IN THE ABSOLUTE DETERMINATION OF α-EMITTERS IN ACUTE ANGLE COUNTERS. Kempf, Wilhelm (Munich Univ. (West Germany)). 1970. 115p. (In German). Dep. NTIS (U. S. Sales Only).

Thesis.

In the use of the small angle counter (low geometry counter) for the absolute determination of α emitters, the lateral displacement of the sample from the central site causes corresponding changes in the counting rate. The eccentricity effects caused by such a displacement are studied. A counting device was constructed which permits a reproducible radial displacement of the sample and its measurement. The pertinent mathematical expression of the modified theory of the low geometry counter was rederived and numerically proved. (J.S.R.)

23839 (ORNL-TM-3252) INVESTIGATION OF BROADBAND CURRENT PREAMPLIFICATION FOR OBTAINING SIMULTANEOUS HIGH-RESOLUTION ENERGY AND TIME INFORMATION FROM NUCLEAR RADIATION DETECTORS. Millard, Joe Kenneth (Oak Ridge National Lab., Tenn.). Mar 1971. Contract W-7405-eng-26. 143p. Dep. NTIS.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

Noise-performance limitations of existing broadband current-amplifying stages are first considered. A new broadband, shunt-feedback amplifier having a current gain equal to the ratio of an RC feedback impedance to an RC load impedance is then described. The value of the feedback resistance and capacitance can be made equal to that of conventional charge-sensitive preamplifiers. Basically, the configuration is similar to that of a charge-sensitive preamplifier; however, differentiation is performed by the feedback network to allow a broadband current transfer function. The stage has a large bandwidth capability with linearity and noise performance comparable to that of the conventional charge-sensitive configuration. Equations predicting the bandwidth, input and output impedances, and noise-performance are derived. A three-stage preamplifier having a current gain of 8000 was constructed to verify experimentally the predicted preamplifier performance characteristics. Energy-resolution experiments performed with a Ge(Li) semiconductor detector yielded noise line widths as low as 2.35 keV FWHM for the integrated current output shaped by a 1.6-microsecond time constant RC-RC filter. Leading-edge timing experiments were performed with a ^{60}Co gamma-ray source. With the test channel consisting of the three-stage preamplifier coupled to a 1.7-cm^3 planar diode, a timing uncertainty of 1.6×10^{-9} seconds FWHM for a 13.3-to-1 dynamic energy range was measured. With a 34.1-cm^3 true coaxial Ge(Li) detector in the test channel, the timing uncertainty was 3.3×10^{-9} seconds FWHM for a 7.8-to-1 dynamic energy range. Rise times as low as 7×10^{-9} seconds were measured with the 9×10^{-12} farad planar detector connected to the preamplifier. (R.W.R.)

23840 (UCRL-20148) DEVELOPMENT OF NEUTRON LEAKAGE SPECTROMETERS WITH EMPHASIS ON THE keV RANGE. Henninger, Rudolph J. (California Univ., Berkeley. Lawrence Radiation Lab.). Mar 1971. Contract W-7405-eng-48. 106p. Dep. NTIS.

Thesis.

Calculations were performed to design and analyze a set of neutron spectrometers consisting of cadmium-covered, spherically-shaped, resonance-absorbing cores, surrounded by various-sized polyethylene spheres. Some of the detectors had an additional layer of boron around the polyethylene. Because of the combined effects of leakage (hence the name) and moderation in the polyethylene, the measured activation of the resonance absorber depends on the incident neutron energy, with a maximum in an energy range determined by the sizes and properties of all the materials. This response is proportional to the adjoint flux, which is calculated by the multigroup discrete ordinate transport code ANISN. The adjoint boundary condition is the probability that a neutron entering the core is captured there. It is assumed that this probability is independent of the presence of the surrounding materials. Calculations were performed for polyethylene sphere diameters varying from 2 to 10 in. to find a set useful in the keV region. Some of these calculations were compared with experiments performed by S. Binney and Hans Mark using nearly monoenergetic keV photoneutrons. The experimental results were typically about 30% different from those calculated. (auth)

23841 DIRECTION DETERMINING GAMMA-RAY DETECTOR. Humphrey, Norman B. (to Texas Instruments Inc.). U. S. Patent 3,539,806. 10 Nov 1970. Filed 8 Mar 1966.

Disclosed is a gamma-ray scintillator detector that determines the direction of a source of gamma-rays without movement of the scintillator detector. Also disclosed are means to distinguish a scintillation of a central scintillator from a scintillation of an outside scintillator when both scintillations are recorded by the same detecting means. (auth)

23842 SINGLE-CRYSTAL, DRIFTED SEMI-CONDUCTOR RADIATION DETECTOR HAVING A BORE THERETHROUGH. Higatsberger, Michael J.; Hick, Harald (to Osterreichische Studiengesellschaft fur Atomenergie GmbH). U. S. Patent 3,546,459. 8 Dec 1970. Priority date 18 Mar 1966, Austria.

A method of producing a drifted semiconductor detector is described. A single crystal is bored through to form a first electrode by the entire outer face of the single crystal and a second electrode by the face of the bore in the crystal. Drift material is applied to one of the electrodes, and a drifting process is brought about by applying a voltage to the respective electrodes. (auth)

23843 STUDY OF GERMANIUM-LITHIUM DRIFTED GAMMA SPECTRUM SHAPES. Pratt, T. A. E. C.; Luther, M. L. (Illinois State Univ., Normal). Nucl. Instrum. Methods; 92: 317-23 (1971).

Various analytic fits are made to the shapes of gamma spectra using a Ge-Li detector and ^{60}Co gamma source. The effect of geometry on the gamma shapes is also discussed. (auth)

23844 APPARATUS FOR MEASURING OF QUANTUM RADIATION. Hick, Harald; Rumpold, Karl (to Osterreichische Studiengesellschaft fuer Atomenergie GmbH). U. S. Patent 3,558,887. 26 Jan 1971. Priority date 4 Nov 1966, Austria.

An apparatus for measuring of quantum radiation, particularly of gamma radiation, is described. The apparatus comprises a first detector for the primary radiation and a second detector for the back-scattered radiation. A coincidence circuit and a measuring device are also provided. The first and second detectors are connected with the measuring device by means of the coincidence circuit. Both detectors have a high resolving power in spite of a complicated response function. An adding device is connected with the detectors, and the output of the adding device is connected with the measuring device. (auth)

23845 PRECISE CALIBRATION OF A Ge(Li)-SPECTROMETER USING A DIGITAL TO ANALOG CONVERTER. McKee, R. J. (National Research Council of Canada, Ottawa); Hargrove, C. K.; Smith, A. G.; (and others). Nucl. Instrum. Methods; 92: 421-32(1971).

A new method to precisely calibrate the linear electronics used with Ge(Li)-spectrometers has been developed. The calibration is done by measuring the system's differential response with a mercury relay pulse generator whose amplitude is distributed over the range of the spectrum by a computer controlled 15 bit digital to analog converter. It is shown that the integral of the differential response, collected simultaneously with the data, linearizes the electronics throughout the whole spectrum range in a model independent way, except for small errors introduced by electronic noise and accidental coincidence with detector events. A test of the calibration system using a small planar detector is presented in which a linear fit of peak position to adopted energy was done for seven γ-ray lines between 100 and 500 keV which are known to very high precision. The rms deviation from the linear fit for two separate runs is less than 3 eV. In addition, a new value of 136.473 ± 0.015 keV is reported for one of the principal transitions of ^{57}Co. (auth)

23846 RESOLUTION EFFECT IN THE MUON-NEUTRINO-GAMMA CORRELATION EXPERIMENT REVISITED. Pratt, T. A. E. C. (Illinois State Univ., Normal). Nucl. Instrum. Methods; 92: 413-19(1971).

Various methods of analyzing the $\mu-\nu-\gamma$ correlation experiment are discussed. In particular, the non-analytic and analytic methods for fitting the resolution effect are compared for any possible deviation from accuracy. (auth)

High Energy Physics Instrumentation

Refer also to abstract 25568.

23847 (AD-711287) RESPONSE OF A SPARK CHAMBER TO INCIDENT NEUTRAL PARTICLES. De Jong, John C. (United

States Naval Academy, Annapolis, Md.). 15 May 1970. 44p. (USNA-TSPR-8). NTIS.

The study was carried out to furnish a suitable detector efficiency or response function for the analysis of neutral cosmic particles. A detector response function has been obtained using a digital computer program to simulate the action of the multiplate aluminum shower scintillation detector. The simulation incorporates the Monte Carlo technique of using random numbers to approximate distribution of physical parameters. The program is flexible. The simulation presently deals with the response to the muon but can easily be expanded to treat as much of the interaction as necessary for further analysis. Seventy-one actual events are available for study and the artificial data derived from the simulation in its present form have correlated in a positive fashion. (auth)

23848 (IFVE-SPK-70-9) CALCULATION AND THE MODEL INVESTIGATION OF THE STRESSED STATE OF THE BUBBLE CHAMBER BODY SKAT. Odintsov, V. N.; Semenov, O. V.; Spirchenko, Yu. V.; Kuznetsov, E. P.; Snyatkov, V. I. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1970. 13p. (In Russian). NTIS (U. S. Sales Only).

The calculation methodics of the bubble chamber body "SKAT" with a thick wall is given. The results of the body stressed state made of aluminium alloy to a scale 1:10 are presented. The measurement results and calculated data for the most stressed section are compared. (auth)

23849 (INS-TCA-28) HORIZONTAL AIR SHOWER TRIGGER SYSTEM BY FAST TIMING METHOD. Takano, Motonobu (Tokyo Univ. (Japan). Inst. for Nuclear Study). Jul 1970. 18p. (In Japanese). Dep. NTIS (U. S. Sales Only).

The frequency of horizontal air showers is less than 1/5,000 of that of vertical air showers. Consequently, the method to trigger when a fixed number of particles enter a detector is not efficient for the pickup of horizontal air showers. A system intended to antigate vertical air showers based on the principle that the particles of vertical air showers reach horizontally located detectors at the same time is described. Five fast timing detectors were placed in a pyramid-shape, four at the bottom corners and one at the apex. Each fast timing detector at the four corners was connected to its respective pulse shaper. The four outputs from the four pulse shapers (25ns pulse) were added in the vertical shower coincidence circuit. Vertical air showers generate simultaneous pulses in the four outputs, and make the added pulse height high. The trigger pulse for data recording is stopped by an antigating method when the coming shower is recognized to be a vertical shower. Results are presented and discussed. (Japan)

23850 (N-70-42520) PROPERTIES OF AN IONIZATION SPECTROMETER EXPOSED TO 10-, 20.5-, AND 28-GeV/c MACHINE ACCELERATED PROTONS. Jones, W. V.; Pinkau, K.; Pollvogt, U.; Schmidt, W. K. H.; Huggett, R. W. (Louisiana State Univ., Baton Rouge. Dept. of Physics and Astronomy. Max-Planck-Institut fuer Physik und Astrophysik, Munich (West Germany)). 1970. 15p. (NASA-CR-110792). NTIS.

An ionization spectrometer was employed in several successful balloon flights in combination with spark chambers and different target materials to study high energy cosmic rays. The same spectrometer was exposed to 10, 20.5, and 28 GeV/c protons from the alternating gradient synchrotron at Brookhaven in order to study its response and to calibrate it at these energies. Some results of the calibration measurements are reported here, including the accuracy of energy measurement, the inelastic interaction cross section for protons in iron, and the inelasticity of the interactions of protons with carbon, iron, and lead nuclei. (auth) (STAR)

23851 (SJC-T-70-2) ANALOG MODEL OF THE MAGNET FOR A BUBBLE CHAMBER. Endo, Kuninari (Tokyo Univ. (Japan). Inst. for Nuclear Study). Aug 1970. 23p. (In Japanese). Dep. NTIS (U. S. Sales Only).

Some experimental study on the magnetic field of the magnet for a bubble chamber was performed, since the effective region of the bubble chamber depends on the uniformity of the magnetic field. The shape of the magnet pole and the current distribution of the magnet coil were investigated. Two analog models (electrolytic cells) of the magnet were constructed to measure the two-dimensional and three-dimensional distribution of magnetic flux density. The magnet poles of two shapes were used, that is, 90° and 45° pole. The radial distribution of the flux density of the three dimensional analog model was in agreement with that of a small model magnet, and the distribution in Z direction was twice as large. There was no difference between the flux density of the 45° and the 90° poles in the two dimensional model. Some difference was observed between the field distribution of the 90° poles with taper and without taper. The gap length (the distance between pole face and a lower coil) and the ampére-turn ratio of an upper and a lower coil affected the flux density distribution in Z and r directions. The spatial distribution of flux density was also investigated. In the three dimensional model, contour lines approached to the pole, and the low flux density region at the gap center was narrow. The lines of force in the two dimensional model were clearly different from those in the three dimensional model. (Japan)

23852 GEOMETRIC FACTOR OF TWO PARALLEL, DIRECTLY OPPOSED, PLANE CIRCULAR COSMIC RAY DETECTORS AS A FUNCTION OF THE ANGLE OF INCIDENCE OF THE RADIATION. Manno, V.; Page, D. E.; Shaw, M. L. (ESTEC, Noordwijk, Netherlands). ELDO/ESRO Sci. Tech. Rev.; 2: 363-80(1970).

The fluxes of isotropically distributed high energy particles measured by particle telescopes in space are linked to count rates by geometric factors which are dependent upon the particular telescope configurations. An analytical method of deriving these geometric factors is described and results using the derivation are given for a range of telescope configurations. The effect of particle incidence angle is considered and the relative efficiency with which a particle may be detected is shown to be a function of the incidence angle. (auth) (France)

23853 EMULSIONS AS DETECTORS AT HIGH-ENERGY ACCELERATORS. Herz, Alfred J. Rend. Semin. Mat. Fis. Milano; 39: 96-101(1969).

From Symposium in Honor of Giuseppe Occhialini on the 20th Anniversary of His Return to Italy, Milan, Italy. See CONF-681083.

The present status of the emulsion method applied to research at high-energy accelerators is discussed. In order to show the usefulness of nuclear emulsions in more detail the analysis of charged-particle beams and the measurement of the magnetic moment of the Λ^0 particle are described. (J.F.P.)

23854 TEST FOR CALIBRATION PROCEDURES IN QUARK TELESCOPE EXPERIMENTS. Briatore, L. (Univ., Turin. CNR, Turin); Sitte, K. Lett. Nuovo Cim.; 1: 101-5(16 Jan 1971).

In order to obtain an idea of the magnitude of errors in the calibration of quark telescopes, a simple test experiment is run comparing simulated and genuine quarklike events. It is found that it is likely that especially for $q = \frac{1}{3}$ the errors introduced by the calibration method may not always be negligible. (J.F.P.)

23855 HIGH RESOLUTION, HIGH STATISTICS BARYON SPECTROMETER. Sannes, F.; Ellis, W. E.; Norem, J.; Silverman, M.; Maglic, B. (Rutgers-The State Univ., New Brunswick, N. J.). Nucl. Instrum. Methods; 92: 345-8(1971).

A magnet-less spectrometer consisting of a point hydrogen target and a scintillation counter hodoscope is described. Recoil protons are selected on the basis of range, time-of-flight, and pulse height. The hodoscope measures the recoil angle in the region of the Jacobian peak. The incident proton momentum, which varies in each event, is measured at each trigger time. Data are displayed directly on a 2-dimensional pulse height analyser, one dimension being the recoil angle, the other the incident momentum, the combination of these giving the mass spectrum. (auth)

Radiation Dosimeters

Refer also to abstracts 24157, 24159, 24162–24164, 24168, 24184, and 24426.

23856 (BNWL-SA-3561) [TISSUE EQUIVALENT PROPORTIONAL COUNTERS IN THIN NEUTRON SHIELD STUDIES]. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). [1970]. 10p. (CONF-710402-1). Dep. NTIS.

From Meeting on Neutron Sources and Applications, Augusta, Ga.

Rossi tissue-equivalent proportional detectors are described, and their ability to distinguish between neutrons and gamma radiation is discussed. Neutron shielding measurements using Rossi detectors are presented, and LET and quality factor analysis using Rossi detectors are discussed. Relations between dose, dose equivalent, kerma, LET, RBE and quality factor are considered. In summary, the ability of the tissue equivalent proportional counter to make absolute neutron dose measurements in a tissue equivalent system is demonstrated. (W.H.K.)

23857 (JINR-P16-5525) INTEGRAL SIGNAL METHODS FOR DETERMINATION OF A DOSE EQUIVALENT. Zel'chinskii, M. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1971. 24p. (In Russian). Dep. NTIS (U. S. Sales Only).

The difference output signal of two tissue dose detectors is proportional to the dose equivalent of a radiation of any composition and energy spectrum if the response of one of these detectors does not depend on LET and the response of the other one is a linear function of QF, usually with negative slope. The integral signal methods of DE determination are based on this principle. (auth)

23858 (MIT-952-7, pp 157-61) PHOTOSTIMULATED EXOELECTRON EMISSION. (Massachusetts Inst. of Tech., Cambridge. Dept. of Physics).

In Radium and mesothorium poisoning and dosimetry and instrumentation techniques in applied radioactivity.

A study of the characteristics of barium sulfate photostimulated exoelectron emission (PSEEE) dosimeters is briefly discussed. (W.H.K.)

23859 PYROLYTIC GRAPHITE MICROCALORIMETER FOR THE MEASUREMENT OF X-RAY ABSORBED DOSE. Kemp, L. A. W.; Marsh, A. R. S.; Baker, M. J. (National Physical Lab.; Teddington, Eng.). Nature (London); 230: 41-2(5 Mar 1971).

The choice of solid reference materials for use in the indirect method for measuring x ray absorbed dose in biological materials is discussed. Graphite would appear to be an obvious choice, but in the case of ordinary graphite its electrical resistivity is too small for it to be used for calibration purposes by Joule self-heating and there are reservations concerning possible irradiation induced reactions associated with gas adsorption. It is thought, however, that both these objections may be overcome by the use of pyrolytic graphite, which is virtually impermeable to gases, and whose marked anisotropic electrical properties can be exploited to achieve calibration self-heating. Following a comprehensive theoretical study of the application of pyrolytic graphite in a "local" absorbed dose microcalorimetric, a prototype was designed and is under construction. The exploitation of the C direction resistivity to provide Joule self-heating for calibration purposes promises considerable simplification of design, and it is planned to operate the instrument so that irradiation and calibration heating proceed simultaneously. (UK)

23860 THERMOLUMINESCENT PHOSPHOR. (to Matsushita Electric Industrial Co., Ltd.). British Patent 1,221,823. 10 Feb 1971. Priority date 29 Jun 1967, Japan.

The preparation and properties of calcium sulfate thermoluminescent dosimeters doped with dysprosium, thulium, terbium, or praseodymium are described. (W.H.K.)

23861 IMPROVEMENTS TO THERMOLUMINESCENT DOSIMETERS. Lafont-Rapnouil, Michel (to Cie Francasie Thomson Houston-Hotchkiss Brandt). French Patent 1,566,753. 31 Mar 1969. Filed 29 Mar 1968. (In French).

A thermoluminescent dosimeter is described in which the thermoluninescent material is firmly bonded to an electrically and thermally conducting support (e.g., graphite). This support can be connected to a source of electric current in order to heat the dosimeter by the Joule effect. The response of the dosimeter to the radiation measured is essentially equivalent to that of soft human tissue or air. (R.W.R.)

23862 LUMINESCENT SUBSTANCE FOR RADIATION DOSIMETER OF THE THERMOLUMINESCENCE TYPE. (to Matsushita Electric Industrial Co. Ltd.). French Patent 1,569,245. 21 Apr 1969. Priority date 29 Jun 1967, Japan. (In French).

A luminescent substance for thermoluminescent radiation dosimeters is reported. The new substance, which is excellent from the point of view of sensitivity to radiation and fixation of the radiation energy absorbed, is reliable and reusable. The principal constituent is calcium sulfate, but 0.005 to 0.2 mole % impurity is added in the form of Dy, Tm, Tb, or Pr. The manufacturing process, exact constitution, material properties, and the procedure for molding the substance are described. (R.W.R.)

23863 PLASTIC RADIATION INDICATOR AND ITS MANUFACTURING PROCESS. Matsumoto, Shoichi; Tsukada, Tomomichi; Umetsu, Kazuo; Fukaya, Hiroyuki (to Tokyo Shibaura Electric Co. Ltd. Toyo Chemical Co. Ltd.). French Patent 1,567,053. 8 Apr 1969. Filed 12 Sep 1967. (In French).

A plastic radiation dosimeter that is essentially polymer containing chlorine and a dye solution is described. The dye is dispersed uniformly in the polymer at a concentration of less than 3% of the weight of the polymer. The color of the dye solution varies in use as a function of the amount of radiation received. The dosimeter can be cast in the desired form by melting and solidification. (R.W.R.)

23864 INVESTIGATION INTO THE POSSIBLE USE OF THERMOLUMINESCENT (ZnS:CdS:Ag:Ni) PHOSPHORS FOR RADIATION DOSIMETRY. Elmanharawy, M. S. (Cairo Univ.). Int. J. Appl. Radiat. Isotop.; 22: 9-15(Jan 1971).

Some investigations are reported into the thermoluninescence characteristics of ZnS: CdS: Ag: Ni phosphors with various host matrix lattice compositions and nickel impurity content, with regard to their possible application for radiation dosimetry. If exposed to Cobalt-60 gamma-rays at room temperature, all phosphors give a thermoluminescent emission, with a peak wavelength of 7000 Å, on heating. All thermoluminescence curves, measured after exposure to gamma-rays, show a single well-defined peak appearing at temperatures above room temperature. This peak shifts to lower temperatures with increase in either the CdS content of the matrix lattice or the nickel impurity concentration. The phosphors are also found to have a linear response with exposure for an exposure range of 1 R to at least 200 R, with an information loss of less than 2 percent over a one-week storage period. (auth) (UK)

23865 HIGH THERMAL CONDUCTIVITY GAS THERMOLUMINESCENT DOSIMETER. Attix, Frank H.; West, Edward J. (to Secretary of the Navy). U. S. Patent 3,555,277. 12 Jan 1971. Filed 27 Jun 1968.

An improved thermoluminescent dosimeter of the type in which the dosimeter material and heater elements are combined into a unitary element is described. The improvement is brought about by increasing the thermal conductivity between the heating means and the thermoluminescent material. (auth)

23866 DEVELOPMENT OF THERMAL LUMINESCENCE DOSIMETER. Kitamura, Saburo (Matsushita Electric Industrial Co. Ltd., Osaka). Genshiryoku Kogyo; 16: No. 10, 46-9; 57(Oct 1970). (In Japanese).

Characteristics of thermoluminescent dosimeters (TLD's) are reviewed; representative TLD materials are mentioned; TLD readout procedures are described; and various uses for TLD's are discussed. (TSS) (Japan)

23867 DOSIMETRY OF NEUTRONS AND MIXED n + γ FIELDS. Tochilin, E.; Shumway, B. W. (Naval Radiological Defense Lab., San Francisco). pp 247-308 of Radiation Dosimetry. Vol. III. /Attix, Frank H. (ed.). New York; Academic Press Inc. (1969).

Dosimetric techniques as they apply to neutron irradiations are reviewed and evaluated. Since gamma rays invariably accompany neutrons and most detecting systems respond to both, information on the detector sensitivity (and its dependence upon radiation energy) is necessary for both types of radiations. In general, two dosimeters with widely differing neutron to γ-ray sensitivities are required in order to separate the dose contributions of the two kinds of radiations. The article concludes with environmental measurements of radiation fields from typical neutron sources presented in tabular form. (129 references) (R.W.R.)

23868 ULTRAHIGH-ENERGY RADIATION AND UNCOMMON TYPES OF PARTICLES. Cowan, Frederick P. (Brookhaven National Lab., Upton, N. Y.). pp 523-55 of Radiation Dosimetry. Vol. III. /Attix, Frank H. (ed.). New York; Academic Press Inc. (1969).

After a brief introduction to the special features and methods of ultrahigh-energy dosimetry, the sources and biophysics of ultrahigh-energy radiation are discussed, including the characteristics of subatomic particles, the interaction of ultrahigh-energy radiation with matter, relativistic particle dynamics, mass stopping power, and quality factors. The radiation fields from ultrahigh-energy machines are described, including the primary beams, scattered radiation, and meson beams. Ionization chambers can be used to measure absorbed dose, absorbed-dose rate, and LET and to determine the radiation composition. Other means, such as counters, foils, and threshold detectors, can also be used. The article concludes with a discussion of depth-dose measurements and personnel monitoring. (74 references) (R.W.R.)

23869 DOSIMETRY IN INDUSTRIAL PROCESSING. Holm, Niels W. (Danish Atomic Energy Commission Research Establishment, Risoe). pp 869-904 of Radiation Dosimetry. Vol. III. /Attix, Frank H. (ed.). New York; Academic Press Inc. (1969).

Some general considerations are drawn up in order to form a basis for an appropriate dosimetry procedure in any specific case. The characteristics of the different radiation sources are examined; and the parameters, such as radiation energy, dose rate, and penetration ability, which may influence the dose distribution, are determined. The types of sources described are γ-emitting isotopes and electron accelerators, although other sources may be treated by methods similar to those discussed here. Questions considered are when and where a dosimeter should be introduced, how accurate it should be, how much effort should be invested, and at what cost. (29 references) (R.W.R.)

23870 DOSIMETRY WITH EXO-ELECTRONS. Kriegseis, W.; Scharmann, A.; Seibert, J. (Justus-Liebig-Univ., Giessen, Ger.). Kerntech. Atomprax.; 13: 11-14(Jan 1971). (In German and English).

Exo-electron emission is attracting increasing attention as a method of solid dosimetry. A brief review of the underlying physical principles of this effect and of its possible uses in dosimetry is presented. (auth)

23871 CALIBRATION ERRORS OF IFK FILMS IN ENERGIES OVER 400 keV. Stavitskii, R. V.; Yarkovoi, E. A. (Moscow Inst. for Graduate Medical Studies). Med. Radiol.; 16: No. 2, 64-6(Feb 1971). (In Russian).

In gamma-radiation energies over 400 keV the characteristic curve of roentgen film, exposed without differential filters, should be lower than the curve obtained as the result of exposure of films under filters due to accumulation curve. The rise in the optic density of film darkening without filters is explained by scattered radiation in the source. The presence of this scattered radiation may cause errors in the monitors which have a significant energy dependence. (auth)

23872 DETERMINATION OF ABSORBED DOSES OF LONG-WAVE ROENTGEN AND GAMMA-RADIATION WITH THE AID OF A DETECTOR OF COMPLETE ABSORPTION. Glezin, F. I.; Krongauz, A. N.; Lyapidevskii, V. K.; Titov, A. A. (Moscow Inst. of Research of x-Ray-Radiology). Med. Radiol.; 16: No. 2, 71-5(Feb 1971). (In Russian).

A thallium-activated cesium iodide total absorption detector for determining the integral absorbed dose and dose of roentgen radiation in the range of 4.8 to 13.4 keV in thin layers of tissue-equivalent substance is described. It is shown that the integral absorbed dose linearly depends upon the area of the irradiated field. (auth)

23873 FAST NEUTRON ISODOSE DATA. Bahr, G. K. (Univ. of Cincinnati). Phys. Med. Biol.; 15: 745-6(1970).

The first letter criticises the proposed implementation of the empirical representation of neutron isodose curves (McGinley (1970)) as this would not fall adequately within the framework of well established dosimetric practice. The technique reported, apart from giving misleading results for surface dose, uses "curve fitting" constants as opposed to numerical parameters to which specific and unambiguous physical significance can be attached. It is stated that analogues of these parameters could be used effectively in defining the interaction of a neutron beam with a phantom, thus providing a method of computing isodose curves for various field sizes, energies, and source-skin distances. In reply to the previous letter it is stated that it would be impossible to obtain many of the parameters quoted in that letter and in addition it is pointed out that empirical depth dose equations such as the one developed in the original article, have uses other than treatment planning. For example existing neutron depth dose distributions reported by various researchers can be compared. (UK)

23874 DIRECTIONAL DEPENDENCE OF EXPOSURE MEASUREMENTS AND THE EVALUATION OF EFFECTIVE ENERGIES OF MEDIUM ENERGY X-RAYS BY FILM BADGES. Paic, V.; Paic, M. (Univ., Zagreb). Health Phys.; 20: 259-65(Mar 1971).

The previously proposed film badge used for exposure measurements as well as for the evaluation of the effective energy to which a film had been exposed, was checked for directional dependence between 0° and 80° when exposed to x rays of effective energies between 23 and 138 keV. The angular dependence of the fractional net photographic densities can be fitted by expressions which take into account mainly the absorption in the photographic layer and in the filters. In some cases an additional parameter is to be introduced. The density of the unfiltered portion of the film badge is almost independent of the angle of incidence in the entire range of effective energies studied. It can therefore be used for exposure measurements at angles up to 80°. The evaluation of the effective energy of x-rays for which the ratio of densities of the unfiltered and filtered portions D_0/D_t are used, is not quite independent of the angle of incidence. Nevertheless, up to angles of 40° or even 50° it is possible to evaluate the effective energy. The error is negligible for angles up to 30° or 40°. (auth) (UK)

23875 ROLE OF TLD ENCAPSULATION IN THE PRODUCTION OF APPARENT FAST NEUTRON INDUCED FADING. Wallace, Robert Henry. Lafayette, Ind.; Purdue Univ. (1970). 116p. University Microfilms Order No. 71-2706.

Thesis.

An experiment was designed which tested the response of ^{7}LiF as well as $Li_2B_4O_7$: Mn to ^{226}Ra gamma rays and accelerator-produced fast neutrons. Gamma exposures were either 0.5, 5, or 50 R, while neutrons whose energies were either 0.26 to 1.0 MeV had fluences of either 10^7, 10^8, or 10^9 n/cm^2. In addition, unirradiated ^{7}LiF and $Li_2B_4O_7$: Mn were tested for the effect of exposure to extreme environmental conditions such as high vs. low humidity, a long vs. short period of nitrogen purging, glass vs. polyethylene encapsulation, and vaporized vs. unvaporized polyethylene. Thermoluminescent response of both irradiated and unirradiated phosphors was determined by glow curve integration. The heating cycle, which ran from 51-56°C to 289-292°C in 60 seconds, was reproduced for each readout by a modified soldering gun operated for 20 seconds at a linear rate to a temperature of approximately 200°C and for 40 seconds at a non-linear rate to the maximum glow curve temperature. Glow curves were recorded on a 400-channel analyzer and then integrated and statistically analyzed by a computer. Results of t-tests made at the .05 level showed that the response of $Li_2B_4O_7$: Mn in the form of a single peaked glow curve was proportional to radiation exposure and additive regardless of radiation or environmental conditions. Glass-encapsulated ^{7}LiF also produced single peaked glow curves which were proportional to radiation exposure and which were additive. Polyethylene-encapsulated ^{7}LiF had a glow curve comprised of two peaks. The response of the first peak was similar to the response of the single peaked glow curve associated with glass encapsulation in that the results were proportional to radiation exposure and additive. However, the second peak, whose size was relatively independent of irradiation treatment, was non-additive with losses ranging from 14 to 54% of the entire glow curve. Results of the environmental study revealed that a relationship existed between polyethylene and the appearance of the second peak. The second peak could be made to appear without irradiation in the presence of either polyethylene vapors or contact with polyethylene in the presence of water. Moisture and length of nitrogen purge affected the size of the second peak. The conclusion was that no loss of gamma dose occurred as a result of fast neutron irradiation of either ^{7}LiF or $Li_2B_4O_7$: Mn. Previously reported fading was actually due to conditions associated with polyethylene encapsulation and possible chemiluminescence of polyethylene. (Diss. Abstr. Int., B)

23876 PROPORTIONAL COUNTER FOR THERMALLY STIMULATED EXOELECTRONS. Attix, F. H. (Naval Research Lab., Washington, D. C.). Int. J. Appl. Radiat. Isotop.; 22: 185-97(Mar 1971).

The design and operational parameters are given for a methane-flow proportional counter suitable for the detection of thermally stimulated exoelectrons. It was found that the resulting pulse-height distributions differ among the four count-rate "glow" peaks in β-irradiated LiF(TLD-100). Higher temperature glow peaks tend to produce larger pulses. Possible explanations are examined. (auth) (UK)

23877 CHEMICAL DOSIMETER FOR MONITORING GAMMA-RADIATION DOSES OF 1 TO 100 KRAD. McLaughlin, W. L. (National Bureau of Standards, Washington, D. C.); Hussmann, E. K.; Eisenlohr, H. H.; Chalkley, L. Int. J. Appl. Radiat. Isotop.; 22: 135-40(Mar 1971).

A simple chemical dosimeter is described for measuring gamma-ray doses useful for insect sterilization, seed-sprouting inhibition, and food shelf-life extension. The radiochromic dye solutions, colorless before irradiation, assume a stable blue-violet color when irradiated to absorbed doses from 1 to 100 krad. The readout may be made either visually, colorimetrically, or spectrophotometrically. The optical density is linear with dose, and the response does not vary with dose rate. (auth) (UK)

23878 AUTOMATED THERMOLUMINESCENCE DOSIMETER READER. Kartha, M. (Ohio State Univ., Columbus). Int. J. Appl. Radiat. Isotop.; 22: 131-4(Mar 1971).

The description of a semi-automatic reader, developed to allow extensive use of thermoluminescence dosimeters in any physical form, for radiation dose measurements is given. The procedure outlined is based primarily on a simple modification of one of the commercial readers. The modified version of this instrument has been in routine use for approximately 3 yr. During this time it has proven to be very dependable and convenient for accurate dosimetric studies. The major advantage of this device is that it can be used in conjunction with any standard multichannel analyser. The analyser and the reader are readily coupled and decoupled, making it unnecessary to dedicate the analyser exclusively to this specific use. It can be employed with thermoluminescent phosphor in the powder and solid forms. (auth) (UK)

Radiometric Instruments

Refer also to abstracts 23709, 23711, 23765, and 25625.

23879 (INP–704) THE APPLICABILITY OF RADIOGAUGES FOR MEASURING THE DENSITY OF FLOWING SOLID-LIQUID MIXTURES. Korbel, K. (Institute of Nuclear Physics, Krakow (Poland)). May 1970. 9p. NTIS (U. S. Sales Only).

The density measurement accuracy of the mixture of liquids and loose solid material, performed under flow conditions, is discussed. The accuracy analysis is based on the results of measurements obtained in investigations of hydromixture-flow, carried out by means of radiometric measuring methods. (auth)

23880 (RLO–2061-1) AN AIRBORNE RADIOMETRIC SNOW SURVEY SYSTEM. Jordan, Paul W. (Montana State Univ., Bozeman). Sep 1970. Contract AT(45-1)-2061. 87p. Dep. NTIS.

A prototype system for the airborne measurement of the water equivalent stored in a snowpack on an inaccessible mountain watershed is described. The ground emplacement consists solely of a radioisotope; the reduction in upward gamma flux is related to snow–water content lying above that source. The airborne system and technique necessary to measure and accomplish this are outlined. The mathematical relationships involved are evaluated; and the method of determining each of the parameters of altitude, airspeed, gamma count, etc. is discussed. Experimental validation is cited. As an adjunct to developing a prototype system for measuring, from the air, snow–water equivalent, it was necessary to design tables and graphs to relate maximum expected snow–water depth to isotope type and magnitude and to shield thickness and weight. Data are developed and presented in graph form, which will allow a quick decision as to the optimum combination of elements for any new snow course site which may be under consideration. (auth)

23881 (SAN–805-1) FEASIBILITY STUDY OF DESIGN AND FABRICATION OF NUCLEAR HELICOPTER LIFT INDICATOR (NUHELI). Final Report, July 1968–July 1970, Phases I and II. Blincow, Donald W. (Tyco Labs., Inc., Pomona, Calif. General Nucleonics Div.). Feb 1971. Contract AT(04-3)-805. 138p. Dep. NTIS.

The development of a nucleonic instrumentation system for continuous on-board indication of helicopter lift capability and the testing of a prototype system in a realistic environment are described. The system uses x-ray backscatter from a ^{85}Kr source and a temperature sensor to measure ambient air density and temperature outside the vehicle and computes gross lift capability in an all-digital computer. Combining the lift capability output with helicopter start gross weight and present fuel quantity provides the pilot with a real-time readout of his lift margin at maximum rotor speed before he commits the vehicle to take off or other critical maneuver. (auth)

23882 CONTROL OF DUST CONCENTRATION IN AIR BY MEANS OF BETA RADIATION. Flattau, Jan. Pr. Cent. Inst. Ochrony Pracy; 20: 311-20(1970). (In Polish).

A beta radiometric system for determining dust concentrations in the atmosphere is described. Various combinations of beta sources, radiation detectors, and sampling filters are discussed. (W.H.K.)

23883 DETERMINATION OF DENSITY AND WATER CONTENT OF MARINE SEDIMENT IN AN UNEXTRUDED CORE USING FAST NEUTRON AND GAMMA RAY ATTENUATION. Corey, J. C.; Hayes, D. W. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Deep-Sea Res. Oceanogr. Abstr.; 17: 917-22 (Oct 1970).

Water content and sediment density were measured rapidly and nondestructively at 2.5-cm intervals along a 75-cm long unextruded core (10.75 cm I.D.) using attenuation measurements of collimated gamma rays (0.66 MeV) and collimated fast neutrons (fission spectrum). The gamma source was 10 mCi ^{137}Cs, and the fast neutron source was ~39 mCi (~70 μg) ^{252}Cf. Nondestructively determined sediment densities and water contents compared well with destructively determined values (mean difference = 0.01 g/cm^3). (auth) (UK)

23884 RADIATION MEASUREMENT INSTRUMENT. Baurmash, Leonard; Harwick, Burton Thomas; Meyer, Jack Tait (to North American Rockwell Corp.). British Patent 1,222,586. 17 Feb 1971. Priority date 26 Apr 1967. United States.

A radiometric scattering method for measuring the volume or mass of a material in large or small quantities (particularly, large amounts of material in storage tanks) is described. The radiation source and detector are placed in the material and shielded from each other. (W.H.K.)

23885 ANGLE OF ATTACK INDICATOR USING A RADIOACTIVE SOURCE AND DETECTOR. Jernigan, Ernest D. Jr. (to Industrial Nucleonics Corp.). U. S. Patent 3,557,366. 19 Jan 1971. Filed 17 Apr 1967.

In order to provide an instantaneous indication of the angle of attack of a body traveling through the air at supersonic speeds, opposite surfaces of the leading edge of the body are provided with nucleonic radiation sources so directed as to intercept the shockwave created by the body with nucleonic radiation, some of which is reflected to radiation detectors also mounted on the body opposite surfaces. The outputs of the detectors are fed to a ratio computer and from there to a visual display device. (auth)

23886 UTILIZATION OF BACKSCATTERING OF FAST NEUTRONS FOR DETERMINATION OF CERTAIN PARAMETERS OF CONTROLLED MEDIUM. Magaev, V. N.; Pozdneev, D. B. (Gorky State Univ., USSR). Zavod. Lab.; 36: 955-6(1970). (In Russian).

The use of fast neutron backscattering for thickness measurements or level measurements is discussed. Experimental results obtained using a Po–Be neutron source and a scintillation detector are presented. (tr-auth)

23887 COMBUSTION PRODUCTS DETECTOR USING A RADIOACTIVE SOURCE AND DETECTOR. Skildum, John D. (to Honeywell Inc.). U. S. Patent 3,560,737. 2 Feb 1971. Filed 2 Aug 1967.

A combustion detector of the ionization chamber type having a pair of spaced anode and cathode electrodes wherein the anode carries a radioactive source of beta particles for causing an ionization current in the interelectrode space is described. The electrodes are supported and positioned to provide an interelectrode space large enough to prevent most of the beta particles, emitted at the one electrode, from traversing the interelectrode space and reaching the other electrode while allowing some of the particles to do so. An electrostatic shield is provided by means of a third electrode surrounding the first two electrodes. (auth)

23888 DEVICE OPERATING AS AN ALTIMETER AND AN ALTITUDE STABILIZER. Gilly, Louis (to Commissariat a l'Energie Atomique). British Patent 1,214,906. 9 Dec 1970. Priority date 23 Mar 1967, France.

A combined aircraft altimeter and altitude-control apparatus is described. Thick and thin sources of alpha particles can be placed opposite a detector which measures their energy after passage through a quantity of air in which they are more or less retarded according to the air pressure. In this way the height of the craft can be measured and, with appropriate servomechanisms, controlled. (R.W.R.)

23889 STUDY OF STABILITY OF DISPERSIVE SYSTEMS BY MEANS OF BACKSCATTERING OF BETA RADIATION. I. SUSPENSIONS OF INORGANIC COMPONENTS OF HYDROPHILIC CHARACTER IN WATER. Jombik, J.; Nemcikova, A.; Schiller, P. (Univ. Komenskeho, Bratislav). Cesk. Farm.; 19: 222-4(Jul 1970). (In Czech).

An attempt was made to employ the intensity measurement of backscattered beta radiation for the estimation of the stability of aqueous suspensions. The atomic method is based on changes in the average atomic number of the measured system caused by sedimentation and on the effects of the adsorption phenomena of the dispersive liquid medium on the solid dispersed phase. Special conditions must be worked out for every heterogeneous system and its concentration. (auth)

23890 PORTABLE NUCLEAR MEASURING GAUGE PROVIDING MULTIPLE RADIATION AND DETECTING POSITIONS. Bless, Paul W.; Clements, Richard F. (to Troxler Electronic Labs.). U. S. Patent 3,544,793. 1 Dec 1970. Filed 11 Dec 1967.

A portable nuclear measuring gage enables material characteristics such as those related to density and moisture to be determined with both backscatter and direct transmission techniques, with source radiation and radiation detection each being obtainable at above surface and plural subsurface positions. (auth)

23891 BOREHOLE FLUID-INFLATABLE RADIOACTIVITY LOGGING TOOL AND METHOD. Youmans, Arthur H. (to Dresser Industries, Inc.). U. S. Patent 3,538,330. 3 Nov 1970. Filed 23 Oct 1965.

A method and apparatus for radioactive well logging is described wherein an instrument, at least partially surrounded by an inflatable bag, is disposed in a borehole at a pre-selected depth. Thereafter, the bag is filled with borehole fluid after such fluid is processed in a chemical cell to alter the neutron capturing power of the fluid. With the bag filled in this manner, the

instrument is raised while logging the earth formations surrounding the borehole. One apparatus disclosed for carrying out this method has a chemical cell connected into a valve-controlled channel so that borehole fluid is passed through the chemical cell to fill the bag. (auth)

23892 SIGNAL CORRECTION SYSTEM FOR WELL LOGGING INSTRUMENT HAVING SHORT AND LONG-SPACED RADIOACTIVITY DETECTORS AND A BORE HOLE CALIPER. Niven, Francis J. Jr. (to Dresser Industries, Inc.). U. S. Patent 3,538,329. 3 Nov 1970. Filed 21 Nov 1967.

A well logging instrument having a gamma ray source, a short-spaced radioactivity detector, a long-spaced radioactivity detector, and a bore-hole caliper is coupled through a logging cable to the surface electronics. The surface electronics includes a pair of counting-rate-meter circuits having closed-loop control over the base-line shift to lessen the effects of noise signals. The surface electronics also includes a bore-hole-compensation circuit, a function-generator circuit, and a signal-comparison circuit functionally interconnected with the pair of counting-rate-meter circuits to provide compensation for the effects of mudcake and bore-hole nonuniformity upon the logging of the density of the formations surrounding a bore hole. (auth)

23893 RADIOACTIVE PROCESS FOR MONITORING THE RATE OF DEPOSITION OR REMOVAL OF A SUBSTANCE ON A BASE SURFACE. Glass, Alfred L. (to U. S. Navy). U. S. Patent 3,546,464. 8 Dec 1970. Filed 23 Apr 1968.

The invention relates to a novel and improved procedure for continuously monitoring the rate at which a material or composition is deposited on or removed from a base surface. The procedure involves the use of a radioactive isotope as one of the ingredients of the material or composition and the maintenance of a continuous record of the concentration of the radioactive isotope in the fluid environment in which the material or composition is exposed. (auth)

23894 USE OF RADIOISOTOPES IN SLUDGE LEVEL DETERMINATIONS. Szuecs, J. (Investor of Water Power Development, Bratislava). Vod. Hospod., Rada B; 19: No. 3, 82-3(Mar 1969). (In Slovak).

An apparatus for sludge level determination using ^{60}Co radiation sources and GM tubes which is under operation in the sewage treatment plant at Nitra is described. The apparatus indicates the presence or absence of sludge at two height levels in the digestion tank according to demands of operation. (NSA of Czech.)

23895 DEVICE FOR X-RAY RADIOMETRIC DETERMINATION OF THE CONCENTRATION OF ELEMENTS IN TEST SPECIMENS. Yakubovich, Solomon Lazarevich; Smirnov, Vasily Nikolaevich; Przhiyalgovskii, Stanislav Mikhailovich; Brylyakov, Georgy Ivanovich; Blinov, Eduard Sergeevich (to Vsesojuzny Nauchno-Issledovatelskii Institut Mineralnogo Syria). British Patent, 1,176,209. 1 Jan 1970. Filed 16 Mar 1967.

An x-ray fluorescence analyzer is discussed which employs a beta backscatter gage to determine the absorption characteristics of the test specimen for compensating for the intensity variations in the characteristic x rays. (W.H.K.)

23896 DENSITY MOISTURE METER USING A RADIOACTIVE SOURCE AND DETECTOR. Seaman, Donald J. U. S. Patent 3,511,997. 12 May 1970. Filed 1 Nov 1966.

A meter, including a radioactive source, shielding means for the source, and a housing surrounding the source and shielding and having a top wall and a cover pivotable from an open position to a closed position relative to the top wall is described. A shaft extends through the top wall and supports the source at its lower end within the shielding. A handle, pivotally coupled to the upper end of the shaft, can be rotated from a first position located inwardly of the closed position of the cover to a second position disposed in an interfering relation relative to pivotal movement of the cover from its open to its closed position. The shaft and the radioactive source are movable from an inoperative, shielded position to an operative position when the handle is in its second position. The handle can not be moved from its second position to its first position when the shaft and source are in their operative position; and the shaft and source can not be moved out of their inoperative, shielded position when the handle is in its first position. (auth)

23897 MULTIPLE DETECTOR SUBMARINE RADIOACTIVITY LOGGING SYSTEM. Grice, Charles Fitzhugh (to Schlumberger Tech. Corp.). U. S. Patent 3,546,456. 8 Dec 1970. Filed 5 Jan 1968.

An illustrative embodiment of the invention shows a radioactivity logging device for measuring the density of the sediment on the bottom of a body of water. A housing containing a neutron or gamma source is towed along the bottom to irradiate the sediment. Also within the housing, a pair of radiation counters that are spaced at different distances from the source respond to neutron reactions or those source radiations that are back-scattered to the housing by the sediment. These two counters indicate the sediment density, the quality of the contact with the bottom, and the homogeneity of the sediment. (auth)

23898 IN-LINE MONITORING OF LOW HEAVY-WATER CONCENTRATIONS. Strindehag, O. (Aktiebolaget Atomenergi, Studsvik, Sweden). Kerntech. Atomprax.; 13: 30-3(Jan 1971).

A photoneutron method for monitoring of low D_2O concentrations in water streams is treated, as well as the design and the performance of a D_2O monitor primarily intended for detection of heavy-water leakage in a reactor station. When a commercially available 3mCi ^{228}Th source is used, this monitor responds in less than 1.5 min to an increase of the D_2O concentration of 0.1% at a sample flow of 10 cm^3/s. With specially prepared gamma sources D_2O concentrations far below this level can be detected. (auth)

23899 NEUTRON WELL LOGGING METHOD AND APPARATUS. Youmans, Arthur H. (to Dresser Industries, Inc.). U. S. Patent 3,558,888. 26 Jan 1971. Filed 12 May 1967.

The radioactivity method and apparatus for measuring the oil in the invaded zone of an earth formation are discussed. The thermal-neutron capture cross section of the mud filtrate is first altered to correspond to that of the formation water, and then the amount of oil remaining in the invaded zone is measured as a function of the macroscopic thermal-neutron capture cross section of the formation. (auth)

23900 BACK-SCATTER OF ENERGY-RICH β PARTICLES FOR MEASUREMENT OF EGGSHELL STRENGTH. Loercher, Konrad (Freie Univ., Berlin). Zentralbl. Veterinaermed., Beih.; No. 11, 283-5(1970). (In German).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

A recently developed method is reported for measuring the strength of the eggshell by determining its surface weight by back-scatter of beta particles. The beta radiation was supplied by a point source preparation of $Sr-^{90}Y$ with an activity of 10 μCi of energy representing the activity of a radiation source in terms of the beta back-scatter of eggshells, the surface area of which is between 50 and 80 mg/cm^2 beneath the saturation thickness at impulse rates in the region of 400,000 imp/min. The detector was enclosed in a measuring apparatus that registered precisely the time for a chosen impulse per 0.001 minutes so that when the time of measurement was 0.2 to 0.3 minutes per 100,000 impulses, approximately 150 eggs per hour could be examined for their eggshell strength and appropriately classified. Compared with previous methods for estimating eggshell strength, the new technique has the advantage of being rapid, precise and reproducible for large numbers of samples and without damaging the shells. (auth)

23901 SOME PROBLEMS CONCERNING THE CHOICE OF RADIOISOTOPES FOR TRANSMISSION TYPE MEASUREMENT METHODS. APPLICATION TO DENSITY MEASUREMENT OF STEAM-WATER MIXTURES. Bede, G. (Technical Univ., Budapest). Period. Polytech., Mech. Eng.; 14: 163-72(1970).

The choice of a source for density measurement by attenuation of radiation is considered. The effects on accuracy of the random character of the radiation source emission and the random deviations arising from the uncertainty of the gage are taken into account. Although there are several low-energy gamma sources available, for density measurement of the water/vapor mixture flowing in steam-generating tubes the best choice turns out to be a bremsstrahlung source formed by bombarding Pb with the electrons from the beta decay of ^{90}Sr. (R.W.R.)

Miscellaneous Instruments and Components

Refer also to abstracts 23805, 24193, 25077, 25141, 25563, and 25984.

23902 (BNWL-1526) A NEW TRIANGULAR ACOUSTIC PULSE: ITS GENERATION AND UNIQUE PROPERTIES FOR NDT APPLICATIONS. Dixon, N. E.; Davis, T. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Feb 1971. Contract AT(45-1)-1830. 35p. Dep. NTIS.

A unique ultrasonic pulse technique for transmitting individual triangular-shaped (either compressional or rarefactional) acoustic pulses is described from which the received unipolar pulse signal

exhibits no transducer resonance or "ringout." The associated transducer model and theory, pulse spectral characteristics, and transducer performance requirements are detailed. Included are experimental data and a partial listing of many inherent advantages of the unipolar pulse such as extremely high range resolution, the complete absence of field effects, extremely broad continuous spectral frequency content, and superior penetration characteristics. Also presented are some specific nondestructive testing applications. (auth)

23903 (BRH/DEP-70-26, pp 183-95) X-RAY MEASUREMENTS AROUND HIGH POWER KLYSTRONS. Lehman, Richard L. (Massachusetts Inst. of Tech., Cambridge).

In Electronic product radiation and the health physicist.

Measurements of leakage x rays from klystrons are presented and discussed. An rf-shielded ionization chamber was used. The x-ray intensity near a break in the shielding of a 40 MW uhf klystron tube that was operated at constant pulse rate frequency and constant pulse length was measured as a function of the high voltage with which the tube was pulsed. Under these conditions and with no rf drive, the x-ray intensity rose with the ninth power of the high voltage in the 140- to 180-keV range, and the mean x-ray energy increased from 78 to 108 keV. When the klystron tube was rf-driven to the level of 12% microwave power output efficiency at fixed high voltage points, the x-ray intensity increased about 5-fold over the undriven values, and the mean x-ray energy rose by about 20%. Similar measurements taken near a leakage point in the lead shielding around a 10 MW S-band klystron operated at constant 120 kV high voltage are reported. (W.H.K.)

23904 (BRH/DEP-70-26, pp 197-213) RADIATION EMISSIONS FROM DEMONSTRATION TYPE COLD-CATHODE GAS DISCHARGE TUBES. Properzio, William S. (Bureau of Radiological Health, Rockville, Md. Div. of Electronic Products).

In Electronic product radiation and the health physicist.

The results of laboratory measurements of the X-ray outputs from various tubes are presented and a summary of the findings of a recent survey of radiation sources found in secondary schools is reviewed. Recommendations regarding use of gas discharge tubes based on these data are given with specific comments directed to the science teacher who uses the equipment, to the distributor, and to the State or local radiological health agencies. (auth)

23905 (BRH/DEP-70-26, pp 423-30) COMPARISON OF MICROWAVE DETECTION INSTRUMENTS. Moore, Robert L.; Smith, Stephen W.; Cloke, Robert L.; Brown, David G. (Bureau of Radiological Health, Rockville, Md. Div. of Electronic Products).

In Electronic product radiation and the health physicist.

The various types of microwave detectors are described and their characteristics discussed. Bolometers including thermistors and baretters, thermocouples, and air pressure systems are three types of thermal detectors that are discussed. Also, a direct electrical energy conversion device which employs a semiconductor diode or rectifier is described. The results of tests of various commercial microwave detectors are outlined. (W.H.K.)

23906 (CEA-CONF-1640) NEW METHOD OF SPECTRAL ANALYSIS. Max, J. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 27 Jul 1970. 33p. (In French). (CONF-700932-1). Dep. NTIS (U. S. Sales Only).

From 6th International Congress on Cybernetics, Namur, Belgium.

Three methods for the measurement of the energy spectral density are described. The measurement procedures used in the filtration method and Fourier transformation of the signals are discussed. Spectral analysis by correlation is considered in great detail, and the means of implementing this method are discussed. Two examples of the use of this third method are given. (J.S.R.)

23907 (CEA-R-4169) MICROWEIGHING AS AN IMPORTANT SOURCE OF ERROR IN ACTIVITY MEASUREMENTS. Le Gallic, Yves (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Mar 1971. 30p. (In French). Dep. NTIS (U. S. Sales Only).

Errors arising in microweighing are greater than generally believed. A comparison was made between the microbalances belonging to three international laboratories. The sources of error observed were inaccuracies in the set of microbalance weights, incorrect setting of the sensitivity adjustment, and non-linearity of the optical scale. It appears that an accuracy superior to 0.2 or 0.3 per cent cannot be expected when weighing a 20 mg mass on a commercial microbalance. Certain discrepancies between international intercomparisons of activity measurements may be explained by these observations.

23908 (CERN-71-6) PROCEEDINGS OF THE 1970 CERN COMPUTING AND DATA PROCESSING SCHOOL, VILLA MONASTERO, VARENNA, ITALY, 30 AUGUST-12 SEPTEMBER 1970. (European Organization for Nuclear Research, Geneva (Switzerland)). 5 Feb 1971. 469p. Dep. NTIS (U. S. Sales Only).

Topics include programming languages, simulation in computer design, data processing in bubble chamber experiments, the impact of computers on nuclear science, computer graphics, integrated cognitive systems-perspectives for the 1970's, on-line experiments in high-energy physics, data structures, algebraic manipulation, and simulation in high-energy physics. (W.H.K.)

23909 (DUN-4238) IMPROVED THERMAL ELECTROMOTIVE FORCE, ZIRCONIUM HYDRIDE DETECTOR. Arnold, D. F. (Douglas United Nuclear, Inc., Richland, Wash.). 10 Oct 1968. Contract AT(45-1)-1857. 14p. Dep. NTIS.

Grit blasting may be used to remove ZrH_4 from the insides of Zr alloy process tubes. Detection of hydride by thermal EMF is a practicable means for in-reactor measurement of the amount of hydride present. Although the thermoelectric effect is thought to indicate mostly surface conditions, it appears to provide a good indication of the hydride concentration in the process tube. Design problems encountered in constructing the instrument and the methods used to overcome them are presented. Complete design details, specifications, and a working manual for use of the detector are included. (R.W.R.)

23910 (HMI-B-102) MODULAR ELECTRONIC SYSTEM FOR COMPUTER-AIDED NUCLEAR EXPERIMENTS. Becker, H.; Klessmann, H.; Pangritz, H.; Wawer, W. (Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany)). Dec 1970. 64p. (In German). Dep. NTIS (U. S. Sales Only).

Construction and operation of a modular instrumentation system for computer-aided experiments in nuclear physics is described. The organization of data transfers between the devices of the experiment and a computer is independent of the type of computer. The interface to a PDP 9 for program-controlled and autonomous data transfers is shown in some detail. (auth)

23911 (IFVE-SEF-70-11) EFFICIENCY OF WEAK LIGHT PULSE DETECTION AND THE AMPLITUDE DISTRIBUTION FOR PHOTOTUBES K14-FQS-50, 56UVP, AND XP-1023. Denisov, S. P.; Karpov, I. I.; Rykalin, V. I.; (and others) (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1970. 20p. (In Russian). NTIS (U. S. Sales Only).

The dependence of the detection efficiency of light pulses, which are weak in intensity and amplitude distribution, upon the power supply for K14-FQS-50, 56UVP and XP-1023 phototubes is studied. Recommendations for choosing the voltage divider that would provide the maximum detection efficiency are given. It is shown, that without a detailed study of the efficiency dependence upon the voltage at the photomultiplier electrodes, it is possible to choose such a divider with the help of a scope. The noise amplitude spectra have been measured. (auth)

23912 (INS-TH-68) SOLID-STATE CONTROL CIRCUIT FOR IONIZATION VACUUM GAUGE. Narushima, Katsuya (Tokyo Univ. (Japan). Inst. for Nuclear Study). Aug 1970. 10p. (In Japanese). Dep. NTIS (U. S. Sales Only).

The control circuit comprises a stabilized DC source, electronic current stabilizing circuit, ionic current detecting circuit, and a filament protecting circuit. (TSS) (Japan)

23913 (ISS-70/5) PHASE-SENSITIVITY MICRO WAVE SPECTROMETER FOR SUPERCONDUCTIVE TRANSITIONS. Flamini, M.; Indovina, P. L.; Rosati, A. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). 2 Mar 1970. 32p. (In Italian). Dep. NTIS (U. S. Sales Only).

A measurement method is described to detect superconductive transitions as a function of the magnetic field applied by means of a phase-sensitivity technique. A detailed description of the modulation parameters is given, according to the criteria followed in EPR experiments. In description of the experimental equipment, particular attention is given to the stabilization system of the microwave generator and to the detection method. Furthermore the resonant cavity associated to the cryogenic system is fully explained. (auth)

23914 (ITEF-779) SYSTEM FOR THE TRANSMISSION OF DATA FROM THE ANALYZER INTO THE COMPUTER. Zhurkin, V. V.; Mikhailov, O. E.; Pribytov, V. I.; Rykov, O. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii

SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1970. 16p. (In Russian). Dep. NTIS (U. S. Sales Only).

A system for the transmission of data from the pulse analyzer AI-4096-3B into the computer "Razdan-3" is described. An interrupt mode is used for the recording of the data. The data may be recorded either by the core memory or on magnetic tape. In either case the recording may be combined with the calculation. The number of transmitted words and their arrangement in memory of the computer are indicated in a program. The system is used for the transmission of the data generated by the flying spot device. (auth)

23915 (UCRL-73032) FIELD INSTRUMENT FOR DETECTING AIRBORNE HALOGEN COMPOUNDS. Nelson, Gary O.; Shapiro, Edward G. (California Univ., Livermore. Lawrence Radiation Lab.). 24 Feb 1971. 33p. (CONF-710505-2). Dep. NTIS.

From American industrial hygiene conference; Toronto, Ontario, Canada (27 May 1971).

A field instrument for continuously measuring the concentration of halogenated compounds has been developed. The principle of operation is based on the spark spectral increase which occurs in the presence of a halogen. The degree of spectral enhancement depends on the concentration of halogenated material present. The instrument can be zeroed in a contaminated atmosphere and has a detection limit of several parts per million for most chlorinated materials. This lightweight (13 pound) ac powered instrument has a 50 millivolt recorder output, a choice of four ranges, and a full scale response time of 3 to 5 seconds. (auth)

23916 DIRECT MEASUREMENT OF THE QUANTUM COUNTING EFFICIENCY OF RCA C31000E/F PHOTOMULTIPLIERS AT 6328 A. Lakes, R. S.; Poultney, S. K. (Univ. of Maryland, College Park). Appl. Opt.; 10: 797-800(Apr 1971).

Direct measurement of the total quantum counting efficiency of the RCA C31000E/F shows that it is about 25 ± 22% lower than the photocathode quantum efficiency in optimized commercial base units. Measurements with an EMI 9558 give similar results and with an Amperex 56TVP give similar although more erratic results due to its higher sensitivity to magnetic fields. The measurement techniques and conditions are described in detail. Diagnostic studies such as the question of dependence of counting efficiency on signal or background count rate are also presented. (auth)

23917 PENETRATION FACTORS FOR POINT GAMMA RAY SOURCES OFF THE AXIS OF CYLINDRICAL HOLE COLLIMATORS. Bell, T. K. (Royal Victoria, Montreal); Spiers, E. W.; Johnston, A. R. Phys. Med. Biol.; 16: 152(Jan 1971).

A small correction is made to a previous paper presenting integral expressions derived for calculating the number of γ-rays detected after penetrating the walls of cylindrical hole collimators from point sources in front of the collimators. (auth)

23918 THEORY OF A VELOCITY FOCUSING INSTRUMENT FOR NEUTRON SMALL ANGLE SCATTERING. Ibel, K.; Schmatz, W.; Springer, T. (Kernforschungsanlage, Juelich, Ger.). Atomkernenergie; 17: 15-18(Feb 1971).

The theory of an instrument for small angle scattering of neutrons is discussed which uses velocity focusing by means of the gravitational field. It has a considerable intensity advantage compared to a conventional instrument. The advantage factor as a function of resolution is discussed together with different ways of using a multidetector system. The application of this method is provided for the small angle scattering instrument which is under construction for the very high flux reactor at the v.-Laue-Langevin—Institut in Grenoble. (auth)

23919 NUCLEAR ENERGY PUMPED LASER. Nielson, Niel E. (to Lockheed Aircraft Corp.). U. S. Patent 3,550,095. 26 Jan 1971. Filed 5 Jan 1968.

A laser device is provided in which the lasing substance is pumped to an energy level consistent with lasing action by radiation from a source of nuclear energy. The source of radiation is contained within the envelope which contains the laserable substance when such laserable substance constitutes a gaseous compound, and is supported in conjunction with the laserable substance when such laserable substance constitutes a solid. Sources of radiation found to be effective include alpha-emitting radioactive material such as polonium-210 and plutonium-238, and gamma-emitting materials such as cobalt, cesium and strontium. (auth)

23920 BEAM WIDTH DEFINING STRUCTURE FOR LINEAR ACCELERATOR RADIOTHERAPY DEVICES. Resnick, Larry (to Varian Associates). U. S. Patent 3,539,813. 10 Nov 1970. Filed 24 Nov 1967.

A pair of heavy metal jaws have facing surfaces which define the width of an x-ray beam passing between the jaws. Each jaw is supported on a threaded shaft perpendicular to the beam axis and a shaft which forms an angle with the threaded shaft. The angle and the positions of attachment between jaws and shafts are selected so that the facing surface on each jaw is maintained substantially parallel to the beam edge as the jaws are moved; this reduces stray radiation at the beam edges. (auth)

23921 CRITERIA FOR THE OPTIMIZATION OF INSTRUMENTAL ANALYSIS BY FLUORESCENCE X-RAYS. Cesareo, R. (Instituto di Fisica della Facolta di Ingegneria, Rome); Frazzoli, F. V.; Mancini, C.; Sciuti, S. Com. Naz. Energ. Nucl., Notiz.; 16: No. 11, 57-70(Nov 1970). (In Italian).

The optimization criteria used to carry out a nondestructive analysis by x-ray fluorescence excitation using standard type nuclear equipment are described. (auth)

23922 PROCEEDINGS OF THE TWENTY-EIGHTH ANNUAL MEETING, ELECTRON MICROSCOPY SOCIETY OF AMERICA, HOUSTON, TEXAS, OCTOBER 5, 6, 7, AND 8, 1970. Arceneaux, Claude J. (ed.). Baton Rouge, La.; Claitor's Publishing Division (1970). 679p. (CONF-701003).

Topics include high voltage and high resolution electron microscopy, electron microscopy in space sciences, image analysis, cytology, histology, viruses, pathology, macromolecules, biological instrumentation and techniques, reproductive biology, instrumentation, scanning electron microscopy, metals, nonmetals, minerals, thin films and crystal defects, and special techniques. (W.H.K.)

23923 HIGH-RESOLUTION RADIORESPIROMETER FOR CONTINUOUS DETERMINATION OF RESPIRATORY $^{14}CO_2$. Jacobsen, Donald W.; Wang, C. H. (Oregon State Univ., Corvallis). Anal. Biochem.; 39: 402-11(Feb 1971).

A radiorespirometer consisting of four separate flow-ion chamber-electrometer detection systems is described. An argon flow system has been incorporated into the flow scheme of the instrument to give faster turnover of respiratory gases in the ion chamber and greater sensitivity for the detection of $^{14}CO_2$, thereby providing higher resolution for the analysis of respiratory $^{14}CO_2$ patterns. (auth)

23924 SCATTERED RADIATION ABSORBERS IN INTRAORAL RADIOGRAPHY. Shawkat, A. N. (Univ. of Pennsylvania, Philadelphia). Oral Surg., Oral Med., Oral Pathol., 31: 439-46(Mar 1971).

In a study of scattered radiation absorbers, lead foil was used as a substitute for the stationary grid. There was a gradual increase in contrast as the thickness of lead foil was increased. A thickness of 0.08 to 0.10 mm. lead provided as much improvement in contrast as the stationary grid. The improvement in contrast was more pronounced at a lower KVP. However, the use of lead foil required an increased exposure in order to maintain an acceptable density level. (auth)

23925 SODIUM PUMP INSTRUMENTATION. Dacey, R.; Davidson, D. F.; Leece, J.; Harrison, E. (United Kingdom Atomic Energy Authority, Risley, Eng.). Nucl. Eng. Int.; 16: 208-10 (Mar 1971).

The PFR mechanical circulating pumps require hydrostatic bearings close to the impeller pump. These are approx. 250 mm dia., with radial clearances of 0.25 to 0.4 mm. Inductive transducers, sealed to withstand Na immersion to 450°C, were developed to measure the bearing clearance. The Na pressure applied to the bearing jets is monitored by an electromagnetic brake-type gauge. The design and application of these instruments are described. (UK)

23926 USE OF POLAROID POSITIVE FILM IN RADIOGRAPHY WITH BEAMS OF THERMAL NEUTRONS. Hawkesworth, M. R. (Univ. of Birmingham, Eng.). Non-Destruct. Test.; 4: 45-8(Feb 1971).

Observations are presented of the density-exposure and reciprocity law failure characteristics of Polaroid Type 57 and Type 52 film in conjunction with NE421 and NE905 light-emitting thermal neutron intensifying screens. The NE421-Type 57 system proved to be the fastest radiographically and also has extremely good reciprocity failure characteristics, which makes it a useful image recorder for radiography with low intensity neutron beams. To carry out the measurements and facilitate the use of Polaroid positive film in radiography, two "cameras" were constructed based on the Polaroid Land type 500 sheet film holder. These are described in some detail as they may be of general interest, and an example is given of their use in locating a waxy blockage in a thick-walled pipe. (auth)

23927 REVISION OF LIPPMANN-HARRIS CALIBRATION OF TWO STAGE SAMPLER USING SHAPE FACTORS. Kotrappa, P. (Univ. of Rochester, N. Y.). Health Phys.; 20: 350-2(Mar 1971).

XUM

Two-stage samplers are used to obtain a respirable size air sample. Standard versions of these were originally calibrated by LIPPMANN and HARRIS (NSA: 16: 17931) using uranium oxide aerosols by assuming that the particles were spherical. Detailed study on shapes of uranium and thorium dioxide aerosols indicated that this assumption is not valid. Experimentally determined shape factors need to be used for accurate calibration. The purpose of the note is to revise the published calibration curves taking into account the shape factors. The revised curves predict 1.8 liters per minute (lpm) as the proper sampling rate instead of 2.8 lpm recommended earlier for 10 mm nylon sampler and 11.8 lpm for ½ in. steel sampler instead of 18 lpm recommended earlier. Revised curves in this note predict the flow rates close to the ones recommended by ETTINGER and ROYER (NSA 24: 2516). (auth) (UK)

23928 FLUX PROBLEM RELATED TO TWO DIMENSIONAL IMAGE DISSECTION. Mathieson, E. (Univ. of Leicester, Eng.). Nucl. Instrum. Methods; 92: 441-2(1971).

An analytical solution is quoted for a flux problem which arose in a recently proposed method for two dimensional x-ray image dissection. (auth)

23929 VERSATILE DELAYED COINCIDENCE SYSTEM. Barton, R. D.; Wadden, J. S. (Carleton Univ., Ottawa). Nucl. Instrum. Methods; 92: 403-12(1971).

A versatile delayed coincidence system is described. The apparatus incorporates new methods of time-scale calibration and walk correction, a supervisory fast coincidence, ADC's in the energy channels as well as in the time channel, and an on-line PDP-8 computer. A fairly complete description of the logic design, computer program facilities and performance is given. As evidence of satisfactory performance we report two lifetime measurements that are in excellent agreement with established values: ^{207}Pb, first excited state: $T_{\frac{1}{2}} = (130.2 \pm 1.5)$ ps; ^{35}Cl, 4.174 MeV level: $T_{\frac{1}{2}} = (-.5 \pm 3)$ ps. (auth)

23930 EXPERIMENTAL STUDY OF A MAGNETIC MASS SPECTROMETER FOR ANALYZING A PLASMA OF NEGATIVE AND POSITIVE IONS FROM A SINGLE SPECTRUM. Geerk, Jens; Thomas, Roger (Orleans Univ., France). Compt. Rend., Ser. B; 272: 33-5(4 Jan 1971). (In French).

Experimental results are presented on a prototype magnetic prism mass spectrometer designed for measuring the composition of the ionosphere; the principles and theory have already been published (Compt. Rend., Ser. B; 262, p. 479, 1966). (France)

23931 MOLECULAR BEAM SCATTERING FROM SINGLE CRYSTAL SURFACES UNDER ULTRAHIGH VACUUM CONDITIONS. West, L. A.; Kozak, E. I.; Somorjai, G. A. (Univ. of California, Berkeley). J. Vac. Sci. Technol.; 8: 430-6(Mar-Apr 1971).

Studies of the angular distribution of scattered atomic and molecular beams from single crystal surfaces give detailed information about the gas–solid interaction. An ultrahigh vacuum system combining molecular beam scattering with in situ observation of the same crystal surface by low-energy electron diffraction is described. A rotating quadrupole mass spectrometer and lock-in detection of the modulated (150 Hz) incident beam provide density profiles of the scattered gases. The scattering of thermal energy helium and oxygen beams from the (100) face of a platinum single crystal is given to demonstrate the types of surface studies that may be carried out in such an apparatus. Data are presented showing the effects of CO adsorption and surface roughness on the scattered beam intensity, and the scattering of various molecular beams from clean and contaminated surfaces. (auth)

Radiation Effects on Instruments and Instrument Components

Refer also to abstract 25226.

23932 (BRH/DEP–70-26, pp 173-81) RF RESPONSE OF RADIATION SURVEY INSTRUMENTS. Bradley, Francis J.; Jones, Alan H. (New York Dept. of Labor, New York. Div. of Industrial Hygiene).

In Electronic product radiation and the health physicist.

The response of Geiger–Mueller, ionization, and scintillation detectors to rf radiation in the range from .085 to 1000 MHz was measured and the results are tabulated. (W.H.K.)

23933 (FOA-4-4454-29) IRRADIATION OF P-N JUNCTIONS WITH 600 keV X-RAY FLASH. Lindstroem, L.; Sigfridsson, B. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). Feb 1971. 50p. (In Swedish). Dep. NTIS (U. S. Sales Only).

Experiments with short pulses of x-radiation on p–n junctions are described. Radiation-induced currents in reversed biased p–n junctions were studied particularly. Comparison is made with a theory describing the decay of the diffusion current. In most cases, the agreement is good. Conventional measurements for determining the minority carrier lifetime and the width of the depletion-layer are described. A development of the so called light spot method shows that this method is sometimes suited for measurements of variations in the width of the depletion-layer. Finally, the number of generated electron hole pairs in Si per unit dose was determined. (auth) (Sweden)

23934 (N–70-37568) FILM DEGRADATION RESULTING FROM MAGNETICALLY TRAPPED PROTONS IN ATM ORBITS. Watts, John W. (National Aeronautics and Space Administration, Huntsville, Ala. George C. Marshall Space Flight Center). 16 Sep 1969. 21p. (NASA-TM-X–53922; MSFC-IN-SSL-N–69-2). NTIS.

Film degradation resulting from trapped protons in the ATM orbit is considered for five films: 103-O, Plus X, Panatomic-X, SWR, and SO-375. The latest Kodak analysis of the NASA data is used to determine film densities as a function of time in a 210-nautical-mile (389-km), 35-deg circular orbit for the films. Dose rates as a function of orbital altitude, inclination, and shield thickness are presented that should be useful in determining film degradation in orbits near the one presented. Film selection is concluded to be the single most important criterion in minimizing data loss due to radiation damage. (auth)

23935 INFLUENCE OF IRRADIATION UPON THE LEAKAGE CURRENT OF ELECTROLYTIC CAPACITORS. Wolschendorf, K. (Univ., Kiel). Atomkernenergie; 16: 177-81(1970).

Wet aluminium electrolytic capacitors were subjected to x-ray irradiation, and the radiation-induced increase in leakage current was studied. The influence of capacitance, temperature, and voltage upon the radiation effect was investigated. The observed increase in leakage current cannot be explained as a photoconductivity effect upon the shunting leakage resistor of the capacitor but is due to a photovoltaic effect which occurs obviously in the aluminium oxide. From the results of the irradiation experiments conclusions are drawn concerning the structure and the conduction mechanism in the anodic oxide layer. (auth)

23936 PROTON-INDUCED CONTAMINANT FILM EFFECTS ON ULTRAVIOLET REFLECTING MIRRORS. Gillette, R. B.; Kenyon, B. A. (Boeing Co., Seattle). Appl. Opt.; 10: 545-51 (Mar 1971).

The effects of thin, polymer contaminant films on the reflectance and scattered light properties of far-ultraviolet reflecting mirrors were studied. Deposition of the contaminant films was induced by irradiating the mirrors with 10-keV protons in a high vacuum environment containing hydrocarbon molecules. Contaminant films were deposited using integrated fluxes up to 10^{16} protons-cm^{-2}, and a flux of about 1.4×10^{11} protons-cm^{-2} sec^{-1}. Contaminant film effects were studied on mirror coatings of evaporated aluminum coated with MgF_2, aluminum coated with LiF, and platinum. Results of experiments showed that a film as thin as 4–5 nm produced large reflectance degradation in selected wavelength bands as a result of interference-type effects. Radiation-induced degradation of MgF_2, LiF, and Al film was shown to be negligible. An oxidation cleaning technique was developed that successfully removed the contaminant film and restored reflectance to nearly preirradiation values. (auth)

23937 COMPARISON OF LOW-ENERGY PROTON DAMAGE IN ION-IMPLANTED AND DIFFUSED SILICON SOLAR CELLS. Stanley, Alan G. (Massachusetts Inst. of Tech., Lexington). Proc. IEEE (Inst. Elec. Electron. Eng.); 59: 321-2(Feb 1971).

A comparison is made of low-energy proton damage in ion-implanted and diffused silicon solar cells. It is shown that ion-implanted cells are more radiation resistant. (auth)

LIFE SCIENCES

Biochemistry, Physiology, and Molecular Biology

Refer also to abstracts 23520, 23546, 24202, 24408, and 25960.

23938 (COO-119-242) RESEARCH IN RADIOBIOLOGY. Annual Report of Work in Progress in the Internal Irradiation Program. Dougherty, Thomas F. (Utah Univ., Salt Lake City. Radiobiology Div.). 31 Mar 1970. Contract AT(11-1)-119. 409p. Dep. NTIS.

Twenty papers and two abstracts of papers are included. Separate abstracts have been prepared for the 15 papers that are within the subject scope of NSA. The remaining 5 papers consider corticosteroid binding, kidney function in dogs, parathyroid-cortisol relations, estrous cycle in beagles, and tumor growth. (P.B.M.)

For abstracts of individual papers see: 23546, 23942, 23990–23995, 24150, and 24331–24336.

23939 (NYO-2735-12) CHEMICAL EFFECTS OF IONIZING RADIATION ON THE INDIVIDUAL AMINO ACIDS WITHIN INTACT AND PURE PROTEIN MOLECULES. Friedberg, Felix (Howard Univ., Washington, D. C. Dept. of Biochemistry). Oct 1970. Contract AT(30-1)-2735. 7p. Dep. NTIS.

The chemical effects of gamma radiation on the individual amino acids within intact and pure protein molecules are discussed. Gamma irradiation of native ribonuclease or lysozyme causes aggregation of the protein molecules. There is no evidence of a marked degradation of the polypeptide chain in the native or in the S-carboxymethylated form of ribonuclease or lysozyme. A major chemical result of the radiolysis of simple peptide derivatives is the formation of amide-like compounds which yield ammonia upon mild hydrolysis. (P.B.M.)

23940 (NYO-2735-13) CHEMICAL EFFECTS ON IONIZING RADIATION ON THE INDIVIDUAL AMINO ACIDS WITHIN INTACT AND PURE PROTEIN MOLECULES. Detailed Report (1970–1971). Friedberg, Felix (Howard Univ., Washington, D. C. Dept. of Biochemistry). Nov 1970. Contract AT(30-1)-2735. 7p. Dep. NTIS.

There is no evidence for extensive degradation of globular proteins upon gamma irradiation even though bond breakage is clearly indicated for such proteins as collagen. Studies were undertaken to establish whether this difference between globular proteins and fibrous proteins is also reflected in the production of propionic acid and acetic acid after irradiation in the dry state and subsequent hydrolysis. (P.B.M.)

23941 HIGH-RESOLUTION ISOTOPE TRACING WITH INDUCED NUCLEAR REACTIONS. Malmon, A. G. pp 179-85 of International Conference on Radioactive Isotopes in Pharmacology, Geneva, 20-23 September 1967. /Waser, P. G. (ed.). New York; John Wiley and Sons Ltd. (1969).

From International Conference on Radioactive Isotopes in Pharmacology, Geneva, Switzerland. See CONF-670998.

Methods are described that circumvent the handicaps associated with conventional autoradiography. This is achieved by providing a large heavily ionizing particle that causes significant damage directly to a thin film. The principle is demonstrated by considering the case of fissionable uranium as a tracer. The nuclear reaction that occurs when ^{17}O is exposed to thermal neutrons is considered for biological tracer uses along with other reactions. (M.C.G.)

Basic Processes

Refer also to abstracts 23923 and 24419.

23942 (COO-119-242, pp 303-11) DIURNAL RHYTHM IN LABELING INDICES OF RAT PERIODONTIUM LIGAMENT FIBROBLAST. Roberts, W. E.; McKay, L. I.; Park, H. Z.; Jee, W. S. S. (Utah Univ., Salt Lake City. Radiobiology Div.).

From Research in Radiobiology.

Incorporation of tritiated thymidine (labeling index) in unstimulated and stimulated rat periodontal ligament (PDL) fibroblasts varied as a function of time of day. Highest levels of thymidine labeling of unstimulated PDL fibroblasts were found at 9 am (2.19%) and 3 pm (1.85%). Lower values were observed at 3 am (1.41%) and 9 pm (1.02%). For stimulated PDL fibroblasts, highest peak labeling was observed when the rubber bands were inserted at 9 am. Lower peak labeling occurred at 3 pm and 3 am. When the rubber bands were inserted at 9 pm, not only was the incorporation of thymidine depressed but the peak labeling time post elastic was delayed somewhat. These data supply ample evidence that the diurnal variation affects the incorporation of thymidine in PDL fibroblasts, and that possibly this is mediated by the adrenal cortex. (auth)

23943 SERUM GROWTH HORMONE LEVELS IN SWINE. Siers, D. G.; Hazel, L. N. (Iowa State Univ., Ames). Growth; 34: 419-30(Dec 1970).

The circulating growth hormone level declines as the pigs become older and larger. The hormone was labeled with ^{125}I. The results of this study, when considered in conjunction with the accepted influences of growth hormone upon growth rate and body composition, suggest that the circulating growth hormone level is negatively correlated with the rate of hormone utilization. Serum samples from different pigs and serum samples taken from the same pig at different times cause significantly ($P < .001$) different amounts of serum damage. (auth)

23944 SENSITIVE NEW IMMUNOASSAY FOR CALCITONIN EMPLOYING LABELED ANTIBODY. Colt, Edward W. D. (Veterans Administration Hospital, Washington, D. C.); Miles, Laughton E. M.; Becker, Kenneth L.; Shah, Narendra J. J. Clin. Endocrinol. Metab.; 32: 285-7(Feb 1971).

Purified ^{125}I-labeled antibody (^{125}I-AB) to porcine calcitonin (CT) was used to measure CT in a new immunoradiometric assay. An immunoadsorbent (IA) consisting of CT diazotized to a cellulose derivative was used to isolate specific antibody from anti-CT antiserum. The antibody was labeled while still linked to the IA, and subsequently eluted with HCl. Prior to the assay the labeled antibody was purified by column chromatography. At the end of antigen-antibody incubation (2 days, 4 C), bound was separated from free ^{125}I-AB by a second incubation (1 min, 25°C) with IA. Concentrations as low as 1 pg/ml of CT could be detected. With this technique, it was found that, in the peripheral serum of young pigs, the level of CT during normocalcemia was 150 to 250 pg/ml, rising during hypercalcemia to a peak of 2 to 4 ng/ml. (auth)

23945 RADIOMETRIC METHOD OF SERIAL MEASUREMENT OF PHOTOSYNTHESIS IN UNICELLULAR ALGAE. Ousheva, N.; Popov, K. (Inst. of Plant Physiology, Sofia). Compt. Rend. Acad. Bulg. Sci.; 23: 1151-4(1970).

Radiometric methods of determining photosynthesis in unicellular algae are investigated. The method studied involves a continuous current of nonradioactive and radioactive carbon dioxide in a closed system with the source of light fixed in the center of the system. (P.B.M.)

Metabolism, Physiology, and Toxicology

Refer also to abstracts 23818, 24043, 24081, 24129, 24134, 24139, 24211, 24219, 24243, 24270, 24319–24326, 24345, 24384, 24386, and 24405.

23946 (AEC-tr-7195) RADIOACTIVE ISOTOPES AND THE BODY. Moskalev, Yu. I. (ed.). Translation of Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969. 458p. Dep. NTIS.

Abstracts were prepared for all of the fifty-six monographs included in the book. (E.E.H.)

For abstracts of individual papers see: 23947–23988, 24060, 24148, 24225, and 24319–24329.

23947 (AEC-tr-7195, pp 12-18) EXTENT OF ^{90}Sr BUILDUP IN THE BODY OF A DOG UNDER CHRONIC ORAL BUILDUP. Buldakov, L. A.; Erokhin, R. A.; Moskalev, Yu. I. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

A study was conducted to establish the maximum ^{90}Sr concentration buildup in the skeleton of adult dogs and its distribution during extended oral administration. Forty-two adult dogs were fed an average daily dose of 0.0003 mCu per kg of body weight of a chloride of ^{90}Sr. Administration was stopped in 14 dogs after 512 days and measurements were taken on the 4th, 8th, 16th, 32d, 129th, 267th, and 512th day after final radioisotope intake. Administration was continued until the 1024th day in the remaining dogs. During chronic oral administration, the concentration was 30 to 200 times higher in bones than in soft tissues. The distribution of ^{90}Sr in the skeleton was nonuniform. The minimum concentra-

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tion was one and one-half to two times lower than the average and was usually observed in the sternum. The maximum concentration was observed in the highly mineralized parts of the skeleton. The buildup of ^{90}Sr in the skeleton continued over the course of 513 to 1024 days and the experimental buildup factor did not exceed 44 ± 2.5. (E.E.H.)

23948 (AEC-tr-7195, pp 19-24) BUILDUP AND DISTRIBUTION OF ^{90}Sr IN SHEEP AND GOATS UNDER SINGLE AND CHRONIC ADMINISTRATION. Burov, N. I.; Antakova, N. N.; Panchenko, I. Ya.; Sarapul'tsev, I. A. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

Experiments were conducted on the behavior of ^{90}Sr in the bodies of sheep and goats following single and prolonged administration of the isotope. One group of animals received a daily dose of 2 μC of $SrCl_2$ and were measured over various periods up to 36 months. A second group was given a single intravenous dose of 1 μC/kg body weight and an oral dose of 10 μC/kg to determine the degree of absorption and retention of ^{90}Sr as a function of age. The absorption of ^{90}Sr from the gastrointestinal tract of sheep and goats decreased with age from 100% in young animals to 5 to 10% in adult animals. The greatest concentration was observed in the cranium and diaphyses of tubular bones and the least in the sternum and vertebrae. During prolonged administration from birth up to two and three years, the maximum buildup factor in the skeleton was observed by the fourth month of age at a level of 44 and 30, and then decreased to 29 to 36 and 22 by the end of the experiment. (E.E.H.)

23949 (AEC-tr-7195, pp 25-31) BUILDUP AND DISTRIBUTION OF ^{90}Sr IN CHICKENS UNDER A SINGLE AND CHRONIC ADMINISTRATION. Koldaeva, K. A.; Annenkov, B. N.; Panchenko, I. Ya.; Sarapul'tsev, I. A. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

The buildup, distribution, and elimination of ^{90}Sr in hens, its transfer along the feed-chicken-egg chain, and distribution of the isotope in the egg and its transfer to the body of the chick were studied. Seventy-five Russian white hens 8 to 9 months old were given 0.025 to 25 uC of $SrCl_2$. One group received a single intravenous dose, one group a single oral dose, and the third group received prolonged oral doses. Resorption of ^{90}Sr from the gastrointestinal tract fluctuated from 50 to 80% of the daily intake. Removal of ^{90}Sr after single administration was subject to an exponential law, T_{eff} = 4.4 days, in which 93% was eliminated over 32 days and T_{eff} = 142 days for the remaining ^{90}Sr. Of the total-body content of ^{90}Sr, 96 to 98% was found in the skeleton and 2 to 4% in the organs and tissues. During chronic oral administration, about 40% of the daily intake was eliminated with the egg. The shell contained 96.5% of the Sr, the yolk, 3.3%, and the albumin, 0.2%. During embryological development, ^{90}Sr was absorbed by the chicks primarily from the shell. (E.E.H.)

23950 (AEC-tr-7195, pp 32-9) DISTRIBUTION AND ELIMINATION OF ^{90}Sr FROM THE SKELETON OF SWINE AS A FUNCTION OF AGE. Burov, N. I.; Sarapul'tsev, I. A. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

Studies were conducted on swine to determine the effects of age on the distribution and elimination of ^{90}Sr from the body. Fifty-three swine divided into five age groups were tested. Four groups were given single oral doses of ^{90}Sr in equilibrium with ^{90}Y and one was given daily doses from birth to 60 days of age. Results showed that ^{90}Sr concentration in different bones of the skeleton after single dosage was a function of the age of the animals. In 2 to 100 day old swine, the elimination of ^{90}Sr from the skeleton was independent of the rhythm of administration. The decrease in the specific activity of the skeleton after final administration of the isotope was basically due to the growth of the skeleton in young animals and due to elimination of ^{90}Sr from the body in adult animals. (E.E.H.)

23951 (AEC-tr-7195, pp 40-3) ON THE PROBLEM OF THE METABOLISM OF ^{90}Sr AND STABLE STRONTIUM THAT IS STABLE IN RATS AS A FUNCTION OF AGE. Lebedev, V. M.; Shvedov, V. L. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

The buildup of stable and radioactive strontium isotopes in rats as a function of age was studied. Male and female rats were fed daily doses of grain moistened with a nitric acid solution of ^{90}Sr and their litters were removed 30 days after birth. The results showed that the character of the buildup of ^{90}Sr and stable strontium in the skeletons coincided and was associated with age peculiarities in the development of the body and had a wave-like pattern. Values for ^{90}Sr and stable strontium content in the skeletons of rats at different ages are given. (E.E.H.)

23952 (AEC-tr-7195, pp 44-8) DYNAMICS OF ^{45}Ca AND ^{90}Sr IN RATS IN THE FIRST DAYS AFTER ADMINISTRATION. Malkina, R. M. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

The daily dynamics of the behavior of ^{45}Ca and ^{90}Sr in rats was studied. The rats were given oral doses of radioisotopes and were sacrificed ½, 1, 2, 4, 8, 12, and 24 hrs after administration. Analysis of the ^{45}Ca and ^{90}Sr content in different parts of the gastrointestinal tract and tissues of the body showed that the daily kinetics of these elements in rats differed even in the absorption process in which ^{90}Sr lagged behind ^{45}Ca. Differences in the distribution of ^{45}Ca and ^{90}Sr were observed in the tissues with ^{45}Ca predominating in the skeleton over a period of days. In the muscles, which are easy exchange depots for the elements, the ^{45}Ca content was greater than ^{90}Sr. Evidently, ^{90}Sr washed out of the skeleton by the blood was not immediately excreted by the kidneys and was deposited temporarily in the muscles. The greater content of ^{90}Sr in the blood-skeleton system, especially in the first four hrs served as proof of the greater mobility of ^{90}Sr as compared to ^{45}Ca. (E.E.H.)

23953 (AEC-tr-7195, pp 49-60) TRANSFER OF ^{90}Sr FROM THE MOTHER TO OFFSPRING THROUGH THE PLACENTA AND WITH THE MILK. Burykina, L. N. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

Quantitative laws for the transfer of ^{90}Sr from female dogs to their offspring during chronic oral intake of the mother and the effects on the progeny after final administration to the mother were studied. The bone tissue of the puppies accumulated, at time of birth, a concentration of ^{90}Sr equal to 17 to 46% of the concentration of the isotope in the skeleton of the mother. The magnitude of placental transfer after final administration to the mother rapidly dropped. The values of the transfer of ^{90}Sr to progeny with the milk of the mother during chronic intake was 10 to 17 times greater than the values of transfer through the placenta. During post-natal development, the entire litter may contain up to 80% of the ^{90}Sr contained in the mother. The kinetics for exchange in progeny of ^{90}Sr entering it through the placenta and with mother's milk is described with a two-component exponential mathematical model with an effective half-life for the hard exchange fraction exceeding 2000 days. (E.E.H.)

23954 (AEC-tr-7195, pp 61-7) BUILDUP OF RADIOSTRONTIUM IN THE BODY OF MICE AND THEIR OFFSPRING UNDER EXTENDED ADMINISTRATION. Shvedov, V. L.; Panchenko, I. Ya. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

Studies were made on regularities in the buildup of ^{90}Sr in adult mice as a function of the quantity of the isotope entering daily, in their young during embryo development and in the post-natal period, and also in the young of different litters born and fed by females that had received ^{90}Sr over an extended time. The results showed that the transfer of ^{90}Sr to the fetus during embryological development from chronic administration to the mother was 0.4 to 0.6% of the total quantity administered and for 15 days up to the nursing period, the amount of ^{90}Sr in the young mice rose by a factor of 15 to 17. The deposition of ^{90}Sr in the bodies of young animals receiving the isotope from birth increased in the first 120 days and dropped in the following 120 to 180 days and by 270 days did not differ from the adult values. The degree of buildup in the skeletons of the mother had a considerable effect on its transfer to their progeny. (E.E.H.)

23955 (AEC-tr-7195, pp 68-74) ELIMINATION OF ^{90}Sr FROM DIFFERENT BONES OF THE SKELETON OF DOGS. Sarapul'tsev, I. A.; Panchenko, I. Ya. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

Data on the dynamics of the elimination of ^{90}Sr from different bones of the skeleton and the values of the daily elimination of radiostrontium through the urine and feces in dogs after single doses are presented. Experiments were conducted on 16 adult dogs given single oral doses of ^{90}Sr. The specific activity of bone tissue decreased with time so that ^{90}Sr was eliminated more intensively from cancellous bones than from compact bones and as a result, a redistribution occurred in the skeleton. Bone tissue can be divided into two parts on the basis of exchange, easy exchange and hard exchange. The elimination from

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the skeleton is described by the sum of two exponents with effective half-lives equal to 18 and 750 days. The rate of elimination of ^{90}Sr as a whole from the skeleton can be determined by studying the radius and the rib or thigh bones, rib, and sternum. The elimination of ^{90}Sr in dogs was two to three times greater through the feces than through the urine. (E.E.H.)

23956 (AEC-tr-7195, pp 75-9) ON THE PROBLEM OF THE APPROXIMATE DETERMINATION OF ^{90}Sr CONTENT IN ANIMALS. Rasin, I. M.; Panchenko, I. Ya.; Sarapul'tsev, I. A.; Burov, N. I. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

A study was made to determine the ^{90}Sr content in the teeth of animals by extracting the teeth and measuring the content by radiometry. To determine the normalization coefficients of different animals nine dogs 30 days old, 30 dogs 3 to 4 years old, four young goats whose mothers had received a single dose of ^{90}Sr, 23 shoats, 7 calves, two adult goats, 21 adult sheep, and three cows were studied. It was found that the ^{90}Sr content in the skeleton could be calculated on the basis of the activity of the teeth by using the following normalization coefficients: 0.4 for dogs and cows, 0.6 for sheep during chronic administration, 0.4 up to 100 days independent of the type of animal and 0.7 for longer periods following a single dose in dogs. The error of measurement did not exceed 30 to 40%. The coefficient of 0.54 can be used for a rough estimate of ^{90}Sr content in the body with an error of 100% independent of administration path or kind of animal. The normalization coefficient was equal to 8 in dosage of animals at a young age with subsequent extended elimination. (E.E.H.)

23957 (AEC-tr-7195, pp 80-6) REGULARITIES IN THE ACCUMULATION-ELIMINATION OF ^{137}Cs IN THE BODY OF ADULT DOGS IN A CHRONIC EXPERIMENT. Moskalev, Yu. I.; Buldakov, L. A.; Yerokhin, R. A. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

The accumulation kinetics of ^{137}Cs in the bodies of dogs was studied for up to 256 days and elimination kinetics of the isotopes was studied up to 256 days following final administration. The results showed that distribution of ^{137}Cs in the soft tissues was uniform. The elimination of the isotope from the muscles following chronic doses occurred with a single constant of 0.0162 and the equilibrium accumulation factor in the muscles of 20 to 28.5 was reached after 128 to 256 days of chronic intake. The maximum permissible concentration for ^{137}Cs for the human body as recognized by the International Commission as equal to 30 μC was considered to have some experimental foundation. However, it was felt that the maximum permissible concentration of ^{137}Cs in water as used by the Commission did not ensure reliable safety and should be lowered by a factor of two. (E.E.H.)

23958 (AEC-tr-7195, pp 87-101) DISTRIBUTION OF ^{137}Cs, ^{90}Sr, AND ^{144}Ce IN THE BODY OF WHITE RATS FOR AN EXTENDED PERIOD AFTER INTRATRACHEAL ADMINISTRATION. Korolev, G. K. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

The content of ^{137}Cs, ^{144}Ce, and ^{90}Sr in the organs of white rats 3 to 12 months after intratracheal administration was studied. As a result of the action of ^{137}Cs on the lungs over an extended period, there occurred filtration of small-celled elements along the vessels and bronchi, hyperplasia of the endothelia of the vessels, and thickening of the interalveolar partitions. Homogenization of the walls of the small vessels and hyperplasia of the peribronchial lymphoid tissue was noted with the extended presence of ^{90}Sr. Cerium-144 caused inflammatory destructive breakdown such as hemorrhages, tearing of the epithelium, interstitial pneumonia, and emphysema. The duration of the stay of the isotopes in the lungs, their radiation form, energy, and half-life had an effect on the magnitude of the absorbed dose. The half-life for the elimination of these isotopes from the critical organs was T_{eff} = 36 days for ^{137}Cs in the muscles, 252 days for ^{90}Sr from the skeleton, 520 days for ^{144}Ce from the skeleton, and 38 days from the liver. (E.E.H.)

23959 (AEC-tr-7195, pp 102-10) ACCUMULATION OF ^{144}Ce IN WHITE RATS AS A FUNCTION OF THE AMOUNT OF THE ISOTOPE ADMINISTERED INTRATRACHEALLY. Korolev, G. K. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

A characteristic of cerium metabolism in the body is its slow absorption from its area of administration. In relation to this fact, experiments were made on the accumulation of ^{144}Ce in rats as a function of the amount of the isotope administered intratracheally. Results showed that the accumulation of ^{144}Ce in the internal organs occurred more rapidly with smaller amounts and was absorbed more quickly by the lungs than with larger doses. Hemorrhages developed in the parenchyma and lobar bronchopneumonia in the lungs following large doses of ^{144}Ce but not with smaller doses. The increased absorption of small doses of ^{144}Ce as compared to larger doses was explained by the absence of tissue damage with the smaller doses. The ability of ^{144}Ce to form radiocolloids and its absorption by proteins increased with the quantity of the isotope administered which evidently lengthened the resorption time. (E.E.H.)

23960 (AEC-tr-7195, pp 111-22) DISTRIBUTION OF ^{46}Sc IN THE BODY OF RATS FOR DIFFERENT PATHS OF ADMINISTRATION. Zalikin, G. A.; Tronova, I. N.; Denisov, I. I. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

Various routes of administration were used to determine the distribution of ^{46}Sc in the bodies of rats. Following intravenous administration, the greatest quantities of the isotope were deposited in the skeleton, liver, and muscles. It entered the blood stream slowly with 33.6% in the blood after one hr, 18% after six hrs, and 41% after one day. Intratracheal administration resulted in a rapid absorption of ^{46}Sc from the lungs but this was reabsorbed from the lungs and deposited in the skeleton, liver, and muscles. Oral administration of ^{46}Sc produced very slow absorption and in small quantities. With an increase in pH, there was a rise in the per cent of the deposition of the isotope in the liver, spleen, and lungs but its content dropped in the skeleton, muscles, and kidneys. (E.E.H.)

23961 (AEC-tr-7195, pp 123-7) DISTRIBUTION OF ^{160}Tb AND ^{161}Tb IN THE BODY OF RATS. Zalikin, G. A.; Tronova, I. N. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

Studies were made on the distribution of ^{160}Tb and ^{161}Tb in rats as a function of the properties of the salt administered and the presence of an isotope carrier, stable terbium. Following intravenous administration the majority of the terbium was deposited in the skeleton (40%), liver (26%), and kidneys (5%). High concentrations were also noted in the adrenal glands, thyroid glands, and ovaries. Terbium was rapidly eliminated from the circulatory system and after six hrs only 0.64% of the administered dose remained in the blood. The presence of an isotope carrier and the properties of the salt had no notable effect on the terbium distribution. (E.E.H.)

23962 (AEC-tr-7195, pp 128-35) DYNAMICS OF ^{210}Po EXCHANGE IN DOGS AFTER A SINGLE SUBCUTANEOUS ADMINISTRATION. Parfenov, Yu. D.; Poluboyarinova, Z. I. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

The distribution and exchange dynamics of ^{210}Po in the organs and tissues of dogs following a single subcutaneous injection of polonium nitrate and the constants characterizing the metabolism of the isotope in the body over an extended period were studied. The results showed that the greatest ^{210}Po concentration appeared in the kidneys, lymph nodes, and liver. The rates of ^{210}Po exchange in the different organs expressed in the form of effective half-lives were very close to each other: 31 days for blood, 32 days for kidneys, 33 days for lymph nodes, 36 days for the adrenal gland, 36 days for the liver and lungs, 40 days for the spleen, and 49 days for the skeleton. (E.E.H.)

23963 (AEC-tr-7195, pp 136-46) ON THE DISTRIBUTION OF ^{233}Pa IN THE BODY OF RATS. Zalikin, G. A. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

Data are presented on the accumulation of ^{233}Pa in the bodies of rats during extended oral administration, the distribution as a function of the quantity of activity introduced, and the effects of complex-forming agents on the quantity of ^{233}Pa deposited in the organs and tissues. The values for the deposition of ^{233}Pa in the tissues and organs were somewhat lower than the calculated values and the accumulation factor did not exceed 0.016. Administration of larger doses resulted in a greater retention of the isotope in the kidneys and liver than that retained following trace doses. Complexing substances had no effect on the final distribution of ^{233}Pa in the bodies of rats. (E.E.H.)

23964 (AEC-tr-7195, pp 147-52) DISTRIBUTION OF URANIUM IN THE BODY OF RATS UNDER A SINGLE ADMINISTRATION OF AMMONIUM DIURANATE TO THE STOMACH. Galibin,

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G. P. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

The distribution of uranium in the tissues and organs of rats following administration in the form of ammonium diuranate was studied. The results obtained indicated that not more than 0.5% of administered quantity was retained in the stomach. The half-life for the elimination of uranium from the gastrointestinal tract was one day and several days for the liver, kidneys, and spleen. Uranium accumulated in the bones for up to four days and was slowly eliminated with a half-life of about 150 to 200 days. The next greatest quantity of uranium was retained in the kidneys. However, the bones were the basic depository of the element in the body. (E.E.H.)

23965 (AEC-tr-7195, pp 153-60) BEHAVIOR OF A CITRATE COMPLEX OF ^{239}Pu IN THE BODY OF RATS AFTER STOPPING CHRONIC INHALATION. Lyubchanskii, E. R. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

The metabolism of soluble plutonium compounds in rats during chronic inhalation was studied. Thirty-three female white rats were subjected to a 10 min inhalation of aerosols of a citrate complex of ^{239}Pu six times a week for 160 days. The data obtained indicated that the lungs, over the course of 400 days of the experiment, was the critical organ in the radiation dose and that the lungs and skeleton were the basic organs for deposition of the isotope with a half-life for elimination from the lungs at 816 days and 92.5 days for the skeleton. Route of administration was not important for lung elimination. It was concluded that the danger of lung damage from inhalation of soluble ^{239}Pu compounds was more serious than was previously presumed on the basis of the distribution model assumed by the International Commission on Radiation Shielding and the behavior of aerosols of soluble compounds in the respiratory organs of a standard man. (E.E.H.)

23966 (AEC-tr-7195, pp 161-7) BEHAVIOR OF ^{241}Am IN THE BODY OF RATS UNDER INTRAPERITONEAL AND INTRATRACHEAL ADMINISTRATION. Tseveleva, I. A.; Erokhin, R. A. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

Experiments were conducted on 88 rats to determine the distribution of ^{241}Am in their organs following intraperitoneal or intratracheal administration. Americium concentrated in the liver and skeleton when it was given intraperitoneally. The maximum content in the liver (64.8%) was observed after one day and after 30 days in the skeleton (14.6% of the administered dose). Almost all (95.6%) of the ^{241}Am was eliminated from the liver at T_{eff} = 14.4 days. Skeletal content decreased at T_{eff} = 406 days. One hour following intratracheal administration of ^{241}Am about 70% of the isotope was observed in the lungs. Elimination occurred with three effective half-lives: 22.4 hrs. (40%), 5.9 days (55%), and 195 days (3%). By the 15th day, 19% of the americium was deposited in the liver and 26.5% in the skeleton. About 93% of the isotope was eliminated from the liver at T_{eff} = 8.66 days and elimination from the skeleton was equal to 298 days. (E.E.H.)

23967 (AEC-tr-7195, pp 168-74) ^{241}Am DISTRIBUTION IN RATS AND THE EFFECT OF COMPLEXING SUBSTANCES ON ITS ELIMINATION. Belyaev, Yu. A. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

The character of the distribution of ^{241}Am in rats and the effects of diethylenetriaminopentaacetic acid (DTPA), a mixture of x-aminopolyacetic acids (X Na–Ca salt PC) with the formula $(CH_2-CH_2)_n-N_{n-1}-CH_2-COOH(Na)$ (Ca), Na Ca salt NNN^{-1}, N'-tetraacetic acid 2,2-diamino-diethylsulphide (TS) and tetracycline in the form of a hydrochloride salt on its exchange were studied. Data on the rate of ^{241}Am elimination from the blood and its accumulation in the skeleton and liver following intravenous administration of $^{241}AmCl_3$ to rats are given. About 55% of the isotope was retained in the liver and 20 to 25% in the skeleton. While ^{241}Am was gradually eliminated from the liver, its content in the skeleton remained constant over half a year. Fifty per cent of the administered dose remained in the blood after 3 min. and only 4% after 2 hrs DTPA and the mixture of X-aminopolyacetic acids had a strong effect on the elimination of ^{241}Am. Tetracycline was least effective. (E.E.H.)

23968 (AEC-tr-7195, pp 175-85) DISTRIBUTION OF ^{132}I AND ^{132}Te–^{132}I IN THE BODY OF RATS UNDER INTRAVENOUS ADMINISTRATION. Korolev, G. K. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

Studies were made on the behavior of ^{132}I and the mixture of ^{132}Te–^{132}I separately following intravenous administration in 24 rats. Maximum accumulation of ^{132}I occurred 2 hrs after administration. The effective half-life for the elimination of the isotope from the body was 2 hrs. Concentration in the thyroid gland during its maximum was greater than the concentration in internal organs by a factor of 1000 to 3000. It was determined that the most effective estimate of the functional state of the thyroid gland with the aid of ^{132}I can be made no later than 4 hrs after administration. The distribution of ^{132}Te and ^{132}I was different. The former accumulated mainly in the liver, skeleton, and kidneys while ^{132}I chiefly accumulated in the thyroid gland. Elimination of the isotopes followed an exponential law. The effective half-life for elimination in a mixture of the two isotopes was equal to 6 days for ^{132}Te and 7 days for ^{132}I. (E.E.H.)

23969 (AEC-tr-7195, pp 186-91) EFFECT OF DIFFERENT PATHS OF ADMINISTRATION ON THE BEHAVIOR OF ^{99}Mo IN THE BODY OF RATS. Kalistratova, V. S.; Moskalev, Yu. I. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

A series of experiments were made to study the effects of the path of administration of ^{99}Mo on its behavior in the bodies of white female rats. The animals were sacrificed after 15 min, 30 min, 1 hr, 6 hrs, and 1, 2, 4, 8, and 16 days following intravenous administration and 1 hr and 5 days following intratracheal, subcutaneous, and oral administration, respectively. The results indicated that ^{99}Mo had a uniform distribution in the body and did not concentrate specifically in any particular organ or tissue. The path of administration had no effect on the character and regularity of its behavior. A high coefficient of resorption was noted for all paths of administration (74.6 to 93%) along with a rapid elimination from the body through the kidneys with a biological half-life for elimination of 14 to 18 hrs. (E.E.H.)

23970 (AEC-tr-7195, pp 192-6) DISTRIBUTION OF ^{54}Mn IN THE BODY OF RATS. Kogan, A. G.; Kalistratova, V. S. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

The distribution of ^{54}Mn in the organs and tissues of rats following intravenous administration was studied in both early and later periods, up to 32 days. The ^{54}Mn activity was measured in urine and feces collected daily and expressed in percent of administered dose. The results showed that ^{54}Mn accumulated primarily in the organs of the reticulo-endothelial system, preferentially in the liver. It was rapidly eliminated from the body in three days, 83% in the feces and 3% in the urine. (E.E.H.)

23971 (AEC-tr-7195, pp 197-208) EFFECTIVE DEGREE OF MEDIUM DISPERSITY, PHASE, AND pH OF SOLUTION ON THE BEHAVIOR OF COLLOIDAL ^{198}Au IN THE BODY. Kalistratova, V. S.; Moskalev, Yu. I.; Serebryakov, N. G. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

The distribution of colloidal ^{198}Au in the organs and tissues of rats following intravenous administration of colloids with varying degrees of dispersal and for the same degree of dispersity but using different types of medium was studied. The effects of phase and of an alkali and acid medium of the colloidal solution of ^{198}Au on its distribution and the rate of elimination from the body were investigated. Colloidal ^{198}Au of differing degrees of dispersal accumulated preferentially in the organs of the reticulo-endothelial system. Behavior of ^{198}Au in the body was determined by the size of the particles of the colloidal solution: the periods and levels of maximum accumulation, the rate of absorption by organs of the reticulo-endothelial system, and the effective half-life for elimination vary. Elimination of the isotope was independent of the degree of dispersion. When different media were used, accumulation in the organs was independent of the media. The value of the ^{198}Au content in the kidneys, lungs, heart, gastrointestinal tract, skin, and adrenal gland did not change but the content in the liver, spleen, lymph nodes, and skeleton varied as a function of the medium. Polyglucin facilitated a higher accumulation in the skeleton, pectin had this effect on the spleen, and an aqueous solution affected the lymph nodes. Colloidal ^{198}Au did not change the nature of its distribution or accumulation regardless of solution acidity. (E.E.H.)

23972 (AEC-tr-7195, pp 209-19) WAYS OF LOWERING ASSIMILATION OF ^{90}Sr UNDER EXTENDED INTAKE WITH

FOOD PRODUCTS. Dubrovina, Z. V. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

An evaluation was made on the problem of lowering the assimilation of ^{90}Sr from food products for cases of chronic intake, which can be solved either by preliminary treatment of the food to lower their ^{90}Sr content or by lowering the dietary assimilation of ^{90}Sr by the organism. In order to eliminate the major concentration of ^{90}Sr from food products, the basic structures of the material must be broken down and as a result, the food value may be considerably lowered. Studies on humans and animals showed that ultimate assimilation of ^{90}Sr is determined by the conditions of absorption from the intestine, which depends on the composition of the entire diet. The addition of calcium to the diet lowered the deposition of ^{90}Sr, while additional vitamin D increased absorption from the gastrointestinal tract. Diets enriched with phosphorus had no effect on either ^{90}Sr or ^{45}Ca. Magnesium, however, acted differently. Studies have indicated that it is a competitor for calcium and strontium but very high concentrations are necessary for any significant effect. Phytins of plant products lower the solubility and assimilation of ^{45}Ca and ^{90}Sr. Additives of pectin substances also lower the retention of ^{90}Sr from the diet. These last two substances have many advantages over other chemical compounds and further research to discover more convenient forms are required in order to use them to reduce the deposition of ^{90}Sr. (E.E.H.)

23973 (AEC-tr-7195, pp 220-5) ABSORPTION OF ^{90}Sr FROM SECTIONS OF THE GASTROINTESTINAL TRACT OF RATS UNDER DIFFERENT DIETS. Dobryakova, G. V. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

The rate of the passage of ^{90}Sr through the digestive tract and the degree of absorption from different sections of the gastrointestinal tract as a function of the composition of the diet of rats was studied. Oral administration of ^{90}Sr through meat, milk, and wheat grain was used. The results showed that the rate of passage of ^{90}Sr through the small intestine was the same for all three food products. The isotope was eliminated from the stomach when administered with milk and meat more slowly than with wheat, but the time of the initial appearance of ^{90}Sr in the large intestine was within the range of 2½ hrs for all diets. Absorption and retention of ^{90}Sr in intact rats and from a bound small intestine was 50 to 30% higher with milk and meat diets than with a wheat diet. The difference in absorption from different diets was evidently caused by different properties of the chyme. Excretion occurred in the entire gastrointestinal tract, but more intensive excretion of ^{90}Sr was observed in the upper section of the small intestine. (E.E.H.)

23974 (AEC-tr-7195, pp 226-35) ON THE PHYSICOCHEMICAL FORMS OF RADIOSTRONTIUM IN FOOD PRODUCTS AND ON THE VALUE OF DIFFERENT COMPONENTS OF THE DIET AND THE PROCESS OF ITS ASSIMILATION BY THE BODY OF RATS. Belova, O. M.; Dubrovina, Z. V.; Dobryakova, G. V.; Malkin, P. M.; Nesterenko, V. P.; Panteleev, L. I.; Fadeev, A. P.; Frolova, E. I. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

Experiments were conducted to determine the form of ^{90}Sr that occurs in food products, and the fractions with which ^{90}Sr is bound in food products. Wheat, rye, potatoes, beets, peas, and meat were tested to determine the amount of ^{90}Sr passing into solution after various treatments. From 6 to 40% of all ^{90}Sr in plant food products was associated with the water soluble fraction of the product and 60 to 70% in meat. The transfer of ^{90}Sr into solution increased after breakdown of the starch and hemicellulose fractions with gastric juice. The solubility of ^{90}Sr increased by 60 to 80% as a result of the action of gastric juice in vitro and during in vivo experiments on rats. The change in the content of the majority of components of the diet, except calcium, did not considerably affect the assimilation of ^{90}Sr by the bodies of rats if these substances entered into the composition of the food products at a level of concentration not exceeding the limits of their content in the natural diet. (E.E.H.)

23975 (AEC-tr-7195, pp 236-40) VALUE OF THE PHYTATE FRACTION OF THE DIET IN THE PROCESS OF ASSIMILATION OF ^{90}Sr BY THE BODY. Nesterenko, V. P. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

Certain stages in the process of ^{90}Sr assimilation in the bodies of rats as a function of form, content, and time of administration of different phytates to the diet were studied. From in vitro studies, it was found that phytic acid forms compounds with calcium and ^{90}Sr in products, the diet, and chyme that are difficult to dissolve. Both the degree of solubility of ^{90}Sr compounds in the food and content of the gastrointestinal tract and the degree of absorption and accumulation in the body diminished with the addition of phytates to the diet. The degree of ^{90}Sr accumulation in the skeleton was a function of the form of the phytate added to the diet. The maximum drop was obtained with the addition of sodium phytate to the diet. The optimal conditions for lowering ^{90}Sr accumulation with the addition of phytin to the feed were by simultaneous administration of both. The possibility of lowering the degree of accumulation in the body under oral administration of the isotope without breakdown of calcium exchange was established in principle with the addition of sodium phytate to the diet. (E.E.H.)

23976 (AEC-tr-7195, pp 241-6) ^{90}Sr AND ^{45}Ca EXCHANGE IN SWINE UNDER RATIONS OF DIFFERENT COMPOSITION. Bakhareva, Z. A.; Dubrovina, Z. V.; Korneev, N. A.; Fadeev, A. P. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

The deposition of ^{90}Sr and ^{45}Ca in the skeletons of 17 swine fed a normal diet and the effects of diets with a different product composition on the assimilation of ^{90}Sr under varying levels of ^{45}Ca intake were studied. The results showed that ^{90}Sr and ^{45}Ca concentration in different bones differed by a factor of two to two and a half. The deposition of ^{90}Sr in the bodies of the pigs increased under a high protein diet. The addition of chalk to a diet deficient in calcium up to the normal requirements proportionally lowered the ^{90}Sr and ^{45}Ca retention in the body. An increase in the daily intake of calcium above the normal physiological level had no effect. The $^{90}Sr/^{45}Ca$ discrimination coefficient (DC) in the diet-bone system in the swine was equal to 0.7 to 0.9. With an increase in the daily calcium intake, the $^{90}Sr/^{45}Ca$ DC, diet-bone, increased. (E.E.H.)

23977 (AEC-tr-7195, pp 247-50) ON THE PROBLEM OF THE EFFECT OF VITAMIN D ON THE ASSIMILATION OF ^{90}Sr AND ^{45}Ca. Dubrovina, Z. V. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

Experiments were conducted to compare the effect of vitamin D on the absorption of ^{90}Sr and ^{45}Ca from the gastrointestinal tract and their retention in the bodies of rats under different calcium contents in the diet and to compare the effect of two different doses of the vitamin. The results indicated that the addition of vitamin D to a diet deficient in the vitamin at a dose of 100 IU/day led to an increase in the retention of ^{90}Sr and ^{45}Ca. This effect was more pronounced with high calcium rations. A high dose of vitamin D lowered the accumulation of ^{90}Sr and ^{45}Ca in the skeleton. Vitamin D acted on the strontium and calcium to an equal degree. (E.E.H.)

23978 (AEC-tr-7195, pp 251-5) CONCERNING CERTAIN MECHANISMS OF THE ACTION OF STABLE CALCIUM ON THE DEPOSITION OF RADIOACTIVE STRONTIUM IN THE SKELETON. Malkin, P. M. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

The deposition of ^{90}Sr and ^{45}Ca in the skeleton was studied as a function of stable calcium in the diet of adult rats. Forty different calcium concentrations were studied ranging from four to 170 mg per day per rat. The results showed that absorption of the isotopes dropped with an increase in dietary calcium. This drop appeared to be especially sharp for calcium dietary content between 5 and 30 mg per day. The percent of absorption of both ^{90}Sr and ^{45}Ca was practically the same in the region of normal and high concentrations of stable calcium in the diet. Results from 5 to 15 mg calcium intake per day are explained as a dilution of the radioisotopes in the intestine by stable calcium. In the range of calcium concentrations above 15 mg per day, simple dilution cannot explain the experimental results. (E.E.H.)

23979 (AEC-tr-7195, pp 256-61) EFFECT OF CALCIUM LEVEL IN THE DIET ON ^{90}Sr ACCUMULATION IN THE SKELETON OF SWINE AND CALVES UNDER DIFFERENT DURATIONS OF ADMINISTRATION OF THE ISOTOPE. Sirotkin, A. N.; Panchenko, I. Ya. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

Studies were made on the effects of calcium level in the diets of swine and calves on the accumulation of ^{90}Sr in the skeleton during chronic oral administration. The percent of retention of ^{90}Sr in the bones of these animals decreased with time. In swine five months of age at the beginning of the experiment, accumulation in the skeleton was 15, 6, and 5% of the administered quantity

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by 64, 147, and 240 days with maintenance of normal calcium in the diets. The retention of ^{90}Sr in the skeletons of calves nine months of age at the start of the study was 8.1, 5.2, and 4% of the total quantity after 140, 293, and 397 days. An excess quantity of calcium in the diet did not lower the accumulation of ^{90}Sr in the skeletons of pigs and calves. The distribution of the isotope in the skeletons of the animals receiving normal and high calcium content diets was the same and was independent of the concentration of calcium in the diet. (E.E.H.)

23980 (AEC-tr-7195, pp 262-6) ON THE EFFECT OF CALCIUM LEVEL IN THE DIET ON ^{90}Sr ELIMINATION FROM THE BODY OF COWS. Sirotkin, A. N.; Burov, N. I.; Korneev, N. A.; Sarapul'tsev, I. A. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

Studies were made on the effects of a calcium deficient ration on the elimination of ^{90}Sr with the milk, retention of the isotope in the body, and its transfer to offspring following a single dose of ^{90}Sr to lactating cows. The results indicated that elimination of the isotope from the body is a function of the dietary calcium content. In cows fed calcium deficient diets, the ^{90}Sr concentration in the milk after 25 days was less than in cows receiving normal calcium diets. Strontium-90 elimination with the milk did not differ with reliability in the experimental and control groups ($P > 0.05$). The ^{90}Sr concentration in the milk of the experimental group was three times higher than in the control group. The accumulation of ^{90}Sr in the skeletons of calves born of cows receiving 16 g of Ca per day was 40% higher than in calves receiving 40 g of Ca per day. A calcium deficient diet slightly intensified the elimination of ^{90}Sr from the skeleton of the cow. (E.E.H.)

23981 (AEC-tr-7195, pp 267-70) ON THE ROLE OF PHYSICOCHEMICAL PROCESSES IN THE TRANSFER OF CERTAIN ELEMENTS THROUGH A SEMIPERMEABLE MEMBRANE. Panteleeva, A. P. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

An attempt was made to evaluate the role of physicochemical phenomena in the absorption process. Model experiments were conducted to determine the values of the permeability coefficients of elements through cellophane and a film of bull bladder. The sorption of these elements on the surface of the intestinal wall of an in vitro rat intestine was also studied. The permeability coefficients for Na, K, ^{137}Cs, Mg, ^{45}Ca, ^{90}Sr, ^{91}Y, ^{144}Ce, and ^{59}Fe are given. The chemical individuality of ^{137}Cs, ^{45}Ca, ^{144}Ce, and ^{91}Y appeared in their absorption on an inactivated intestinal wall. Cesium and calcium are mobile elements and were sorbed in slight quantities and easily desorbed while yttrium and cerium were sorbed relatively stably. (E.E.H.)

23982 (AEC-tr-7195, pp 271-4) PHYSICOCHEMICAL STATE OF SODIUM, CESIUM, CALCIUM, STRONTIUM, AND YTTRIUM IN BLOOD SERUM. Puchkova, S. M. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

Studies were made on the physicochemical state of ^{24}Na, ^{137}Cs, ^{45}Ca, ^{90}Sr, and ^{91}Y in the blood serum of animals following intravenous and subcutaneous administration and in the blood serum of humans to which the isotopes were added in vitro. The following series can be formed in terms of the capacity of protein to form complexes with the elements studied: Y > Ca > Sr > Na > Cs. Yttrium was bonded primarily with α- and β-globulins. The preliminary data obtained indicate that calcium was bonded to a greater degree in a quantitative sense than ^{90}Sr. This may have some effect on the subsequent kinetics of these elements in the body. (E.E.H.)

23983 (AEC-tr-7195, pp 286-91) DISTRIBUTION FUNCTION OF ^{90}Sr AND CERTAIN REACTIONS OF THE BODY UNDER SINGLE AND CHRONIC ADMINISTRATION. Panteleev, L. I.; Shvedov, V. L.; Panchenko, I. Ya.; Grebenyuk, N. G.; Goloshchapov, P. V. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

Studies were made on the role of ^{90}Sr distribution in the diets of animals, accumulation processes, and the effects of rhythm of intake on the frequency distribution of ^{90}Sr concentrations in the skeletons of mice. The frequency distribution of certain biological reactions under conditions of the experiment was also studied. The animals were given oral doses of ^{90}Sr for six months and then sacrificed. The results showed that the ^{90}Sr frequency distribution in diets and skeletons of the mice was described with 90% reliability by a normal distribution function. The ^{90}Sr frequency distribution in the skeleton depends on the form of the frequency distribution in the diet. Quantitative indexes of peripheral blood, chromosome disturbances, and weight of the spleen and the body of the mice after ^{90}Sr dosage were also described by a normal distribution function. Statistical analysis of data obtained could be carried out on the basis of a normal distribution law. (E.E.H.)

23984 (AEC-tr-7195, pp 304-8) BIOELECTRIC PHENOMENA AND QUANTITATIVE EVALUATION OF THE FUNCTIONAL STATE OF CERTAIN CELLS ON A BACKGROUND OF CHRONIC ^{90}Sr INTAKE. Korytnyi, V. S. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

Data are presented on electrophysiological studies that were conducted under conditions of chronic intake of ^{90}Sr into the bodies of rats. Measurement of the sedimentation capacity of blood cells, bone marrow, and spermatozoa showed an increase in the rate of precipitation of bone marrow and spermatozoa cells with a rise in the dose and slight changes in the rate of sedimentation on the part of blood cells. The changes observed in the rate of precipitation associated with losses of space charge by the cells probably reflected a decrease in the degree of nativism of the protoplasm and their functional value in the relative radioresistance of blood cells. The rate of formation of intracellular potential of muscle fibers of rats born of animals dosed with ^{90}Sr was a function of the age of the animals and the quantity of the isotope. This relationship had a phase nature and in reflecting the rates of ontogenetic development of the body during chronic intake of ^{90}Sr, confirmed the subordination of the value of ontogenetic reactions to general principles of the reaction of living structures. (E.E.H.)

23985 (AEC-tr-7195, pp 364-75) MICRODISTRIBUTION OF ^{239}Pu AND THE HISTOPATHOLOGY OF THE LIVER AND SKELETON OF DOGS AFTER INTRAVENOUS ADMINISTRATION OF THE ISOTOPE. Bukhtoyarova, Z. M.; Nifatov, A. P. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

Studies were made on the microdistribution of ^{239}Pu in the bone and liver and the dynamics of changes in these organs under the incorporation of ^{239}Pu in dogs. Thirty-six dogs were given intravenous injections of ^{239}Pu in the form of a nitrate solution. The greater portion of the isotope concentrated in the liver was distributed in the form of aggregates in the reticulo-endothelial elements of the liver and the smaller part was in the form of diffusely positioned tracks in liver cells and other structural elements of liver tissue. Dystrophic changes were noted in the peripheral parts of lobules and in later periods annular atrophic cirrhosis of the liver resulted. Plutonium was localized in all structural elements of the bone and bone marrow, but the greatest content was noted in the metaphysis of the tubular bones, especially in the bone marrow, endosteum, periosteum, and, to a smaller degree, the bone tissue itself. Breakdown in osteogenesis was not placed within the framework of physiological regeneration and pretumorous changes were noted after 6 months and osteogenic sarcomas were observed after 2 to 4 years. (E.E.H.)

23986 (AEC-tr-7195, pp 376-87) BEHAVIOR OF ^{239}Pu AND THE HISTOLOGICAL PICTURE OF INJURY OF THE SKELETON AND LIVER OF RATS UNDER SINGLE AND CHRONIC INTAKE OF THE ISOTOPE. Lyubchanskii, E. R.; Bukhtoyarova, Z. M.; Koshurnikova, N. A. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

Studies were made on the accumulation and elimination of ^{239}Pu during chronic intake as a function of duration of administration and under a single administration in animals of different ages and also on the nature of the microdistribution of ^{239}Pu and histology of the organs under different doses and rhythms of administration. Plutonium-239 citrate was administered intraperitoneally to 266 male rats either with one dose or with chronic doses totaling the single dose. The magnitude of the deposition of ^{239}Pu in the skeleton decreased, did not change in the liver, and increased with age in the kidneys following single doses. Elimination from the skeleton and kidneys occurred with the same biological half-life and with two half-lives from the liver. The rate of elimination was independent of age and injected dose. The histology of the bone tissue and liver showed high effectiveness of α-radiation in the chronic administration of the isotope. (E.E.H.)

23987 (AEC-tr-7195, pp 397-404) A COMPARISON OF THE BIOLOGICAL EFFECT OF ^{131}I, NOISE, AND THEIR COMBINED ACTION ON DOGS. Mukhamedov, T.; Kazbekova, D. A. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

Studies were made on the level of accumulation of ^{131}I, alone and in combination with noise, and the hematological and morphological changes in the internal organs of dogs due to these factors. Daily doses of 4 to 5 μCi of ^{131}I were administered subcutaneously for eight months and one-half of the group were subjected to three

hrs of noise equalling 100 to 105 db. Changes in the functional state, thyroid gland, and the blood system were more acute in dogs under the combined action than under the administration of ^{131}I alone. Pathomorphological disturbances in the endocrine and sex glands in dogs of the combined group were greater in comparison to those receiving ^{131}I alone. Injury to the kidneys under the combined action was less severe, which caused less elimination of ^{131}I with the urine than under extended intake of ^{131}I alone. (E.E.H.)

23988 (AEC-tr-7195, pp 413-21) FEATURES OF THE DEVELOPMENT OF THE HEART OF RATS INJECTED WITH ^{90}Sr. Smirnova, E. I.; Lyaginskaya, A. M. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

Experiments were conducted to clarify the effects of ^{90}Sr on the development of the heart, especially on the differentiation of the myocardium, and to study nuclein and carbohydrate metabolism in myocardium of fetal white rats following single intraperitoneal administration to the maternal parent. The weight of the heart of the fetus and offspring of irradiated females was less than in the control, particularly in the postnatal period. The cardiac coefficient increased which can be explained by the appearance of a new compensatory function of the heart. Changes in the form of the heart, abnormal differentiation of the auricles, a disproportion in the dimensions of the atria cordis and ventricles, a change in the structure of the myocardium, and other anomalies appeared. The DNA, RNA, and glycogen content in the myocardium increased considerably. The greatest changes in the development of the heart were observed in the group that was paired on the 160th day following ^{90}Sr administration. This was explained by progressive radiation sickness in the females and, to a smaller degree, by direct action. (E.E.H.)

23989 (BNWL-SA-3469) TOXICOLOGY OF INHALED PLUTONIUM: EXPERIMENTAL ANIMAL STUDIES. Bair, W. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). [1970]. Contract AT(45-1)-1830. 43p. (CONF-700930-2). Dep. NTIS.

From Seminar on radiation protection problems relating to transuranium elements; Karlsruhe, Germany (21 Sep 1970).

Results are reported from extensive studies on dogs of the uptake and subsequent tissue disposition of several inhaled plutonium compounds including $^{239}PuO_2$, $^{239}Pu(NO_3)_4$, and $^{239}PuF_4$ and several types of $^{239}PuO_2$ and $^{239}PuO_2$ aerosols of different particle size distributions. Plutonium dioxide calcined at 1000°C showed maximum retention, while $Pu(NO_3)_4$ was cleared most rapidly from the lung, although even in the latter case 40 to 50 percent of the alveolar deposited plutonium was retained in the lung after three months. Of the PuO_2 aerosols studied, those composed of the smallest sized particles showed the greatest rate of clearance from the lung. Except for $Pu(NO_3)_4$, which translocated principally to bone and liver, the tracheobronchial lymph nodes accumulated the major fraction of plutonium translocated from the lung, amounting to 40% of alveolar deposited PuO_2. Data from nearly 100 dogs, some followed for as long as 9 years, were used to develop a mathematical model for inhaled PuO_2 in dogs. The half-time for pulmonary retention of alveolar deposited plutonium was about 1000 days. Excretion was principally via the feces. Lymphopenia was the most consistent clinical observation in animals with lung burdens. Long-term effects include pulmonary neoplasia which has occurred in 22 of 30 dogs that have survived more than 2.5 years after deposition of about a microcurie or more. (auth)

23990 (COO-119-242, pp 131-44) SUBCELLULAR DISTRIBUTION OF PLUTONIUM IN THE LIVER AND ITS ASSOCIATION WITH FERRITIN. Stover, Betsy J.; Bruenger, Friedrich W.; Stevens, Walter (Utah Univ., Salt Lake City. Radiobiology Div.).

From Research in Radiobiology.

In canine livers $^{239}Pu(IV)$ is distributed ubiquitously at the subcellular level. Livers from beagles injected with $^{239}Pu(IV)$ in citrate buffer and sacrificed at times ranging from 7 to 1539 days after injection were separated by differential centrifugation. Significant concentrations of plutonium were found in the subcellular particles, the cytosol, and the connective tissue. Concentrations in the mitochondrial-lysosomal fractions and microsomal fraction were the highest. Like Am(III) most of the plutonium in the cytosol was bound to ferritin. Smaller fractions of plutonium were found in the very high molecular weight components (probably lipofuscin) and some with an unidentified low molecular weight material. Pure Pu-containing ferritin was separated by gel electrophoresis and by ultracentrifugation. The high concentration of plutonium in the microsomal fraction was due to contamination by ferritin which was heavily loaded with iron. (auth)

23991 (COO-119-242, pp 152-75) THE DISTRIBUTION OF ^{210}Pb IN CANINE BLOOD AFTER INTRAVENOUS INJECTION AND THE ASSOCIATION OF THE NUCLIDE WITH BLOOD CONSTITUENTS IN DOGS AND HUMANS. Bruenger, Friedrich W.; Stevens, Walter; Stover, Betsy J. (Utah Univ., Salt Lake City. Radiobiology Div.).

From Research in Radiobiology.

A preliminary report on the distribution of ^{210}Pb in blood after intravenous injection is presented. The continuation of the study will be published later. After intravenous injection of ^{210}Pb into beagles, the nuclide reached its maximum concentration in blood several hours after administration. Most of the ^{210}Pb was associated with blood cells. The concentration in blood was measured for 287 days after injection at which time 0.058% of the injected dose was still circulating. In vitro experiments with canine and human blood showed that about 90% of the nuclide combined with the red cells was associated with the red cell cytoplasm and less than 10% was bound to the stroma. Transfer across the red cell membrane was possible without prior binding of the nuclide to plasma proteins. After gel chromatography the disc electrophoresis, most of the lead was found in hemoglobin containing fractions. In the dog varying amounts were also found in fractions of high electrophoretic mobility. In humans the largest fraction of ^{210}Pb was found with a minor hemoglobin band. Only after saturation of this fraction were greater quantities found in the main hemoglobin band. (auth)

23992 (COO-119-242, pp 176-91) PROTRACTED HEPATIC, SPLENIC, AND RENAL RETENTION OF ^{239}Pu IN THE BEAGLE. Stover, Betsy J.; Atherton, David R.; Buster, Dawn S. (Utah Univ., Salt Lake City. Radiobiology Div.).

From Research in Radiobiology.

Retention of plutonium in liver, spleen, and kidneys of beagles injected intravenously with $^{239}Pu(IV)$ in citrate buffer at injected dose levels of 0.016 and 0.048 μCi/kg has been measured from young adulthood to death. Dogs at 0.016 μCi/kg suffer no life-shortening, and those at 0.048 μCi/kg, 18%. Hepatic retention is independent of dose level at these and the previously reported level of 0.096 μCi/kg, and, thus, at these levels the radiation damage is not sufficiently extensive to result in a significant dose level effect. Sets of hepatic retention equations have been calculated and those most appropriate for calculation of radiation dose have been designated. Surprisingly, splenic and renal retentions were higher than anticipated from results at higher levels. This may be the consequence of more nearly normal skeletal biology at low levels. (auth)

23993 (COO-119-242, pp 282-302) CORTISOL AND MINERAL TRANSPORT-EFFECT OF TIME AND GRADED DOSES UPON ^{85}Sr RETENTION IN YOUNG AND ADULT RATS. Kenner, G. H.; Jee, W. S. S.; Park, H. Z. (Utah Univ., Salt Lake City. Radiobiology Div.).

From Research in Radiobiology.

A whole-body counting study was done to investigate the long term effect of graded doses of cortisol on previously incorporated ^{85}Sr in the bones of 60 female Sprague-Dawley rats weighing about 200 g. The ^{85}Sr kinetics study showed statistically significant increases in the retention of radionuclide which appeared first in the group injected with 50 mg of cortisol/kg body weight/day on day 2 and gradually extended to the 20, 5, and 2 mg/kg groups by the end of the experiment (149 days). This was in contrast to the statistically significant decrease in ^{85}Sr retention which appeared at 58 days in the 0.6 mg/kg group. By 134 days this difference was nonsignificant and by 149 days the mean value was the same as that of the controls. Postmortem examinations showed decreases in soft tissue weights at the 2 mg/kg level but failed to find any significant differences in either the amount of bone present in the tibial metaphysis or in the density of the femoral or humeral midshafts or the sixth lumbar vertebral body at day 150. (auth)

23994 (COO-119-242, pp 312-53) CORTICOSTEROID AND BONES. Jee, Webster S. S.; Park, Han Z.; Roberts, Wilbur E.; Blackwood, Edward L.; Kenner, Gerry H. (Utah Univ., Salt Lake City. Radiobiology Div.).

From Research in Radiobiology.

Cortisol administration enhanced the reduction in bone volume by: increasing progenitor cell proliferation at low dose levels, decreasing progenitor cell proliferation at high dose levels, shortening the time interval to mobilize cells to enter the cell cycle at low dose levels, delaying the time interval to mobilize cells to enter the cell cycle at high dose levels, inhibiting osteoblastic differentiation, and enhancing osteoclastic differentiation. Low doses were more effective in reducing bone volume than high doses by making more progenitor cells available for differentiation and speeding up the mobilization rate of cells to go into the cell cycle. Cortisol administration altered the ^{85}Sr kinetics in bone and teeth by: enhancing the surface ^{85}Sr store exchange, decreas-

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ing the efflux of deep ^{85}Sr store in bone, and enhancing the efflux of deep ^{85}Sr store in teeth. The decreased efflux of the deep mineral store of bone by cortisol coupled with the well established observation that cortisol inhibits bone formation and thus the formation of new crystals may partially contribute to the observed increase in bone density after cortisol. (auth)

23995 (COO-119-242, pp 377-84) RETENTION OF INJECTED ^{239}Pu BY CHINCHILLAS. Lloyd, Ray D.; Mays, Charles W.; Taylor, Glenn N.; Atherton, David R. (Utah Univ., Salt Lake City. Radiobiology Div.).

From Research in Radiobiology.

The total-body retention of ^{239}Pu was determined in 6 adult male chinchillas. Measurements extended to about 1000 days after intravenous injection in citrate buffer. Retention is lower in chinchillas than in dogs. In these chinchillas ^{239}Pu was retained as if 63% of the injected atoms had a biological half-time of about 11 days and 37% had a half-time of 1475 days. In 2 animals dying 148 and 162 days after injection, about 85% of the retained plutonium was in the skeleton, 9% in the liver, and 6% in other soft tissues. (auth)

23996 (JPRS-52583) TOXICOLOGY AND HYGIENE AFTER NUCLEAR OR BW ATTACK. Translation of articles from Veterinariya; 47: No. 11, 54-6; 79-81(Nov 1970). 11p. NTIS.

A separate abstract was prepared for one section of this report. The other section discusses the protection of domestic animals against biological warfare agents. (C.H.)

For an abstract of an individual section see: 23997.

23997 (JPRS-52583, pp 7-11) TOXICOLOGY OF NUCLEAR EXPLOSION PRODUCTS. Brief Literature Survey. Ilin, V. G. Translated from Veterinariya; 47: No. 11, 79-81(Nov 1970).

A brief survey of Russian-language literature on the toxic effects of fresh (two to three months old) fission products released during nuclear explosions in dogs, cattle, sheep, and rabbits is presented. The fission products were added to food or administered through skin abrasions. The tissue distribution and excretion of mixed fission products, radioactive fused particles, and individual radioisotopes, including ^{99}Mo, ^{131}I, ^{132}I, ^{132}Te, ^{89}Sr, $^{140}Ba-La$, ^{103}Ru, and ^{95}Zr were studied as a function of time following uptake. The studies indicated that about two-thirds of the radioactivity was eliminated within the first two to three days following uptake, the highest amount remained in the thyroid, with decreasing amounts remaining in the gastrointestinal tract, liver, and bones. The radioactivity in the thyroid was attributed to ^{131}I uptake. The gastrointestinal tract was considered the critical organ. No bibliography is included. (C.H.)

23998 (NYO-3917-3) MORPHOLOGICAL AND HISTOCHEMICAL CHANGES IN BONE CELI S AFTER IRRADIATION; A LIGHT AND ELECTRON MICROSCOPE STUDY. Final Progress Report, November 1, 1969-October 31, 1970. Doty, Stephen B. (Johns Hopkins Univ., Baltimore, Md.). Contract AT(30-3)-3917. 19p. Dep. NTIS.

Initial studies were designed to show cellular changes following irradiation. Consequently, the change in bone marrow cell cycle time and the formation of micronuclei were created by ^{45}Ca deposition within skeletal tissue. This isotope was incorporated within the calcifying skeleton thereby irradiating the surrounding tissues continually. The most obvious effect was a gradual change in cell numbers; cell structure was not particularly altered. Calcium-45 distribution in collagen and bone cells was studied using autoradiography and electron microscopy. A standard model was developed for determining the resolution of the autoradiographic procedures using mitochondria isolated from rat liver and incubated in ^{45}Ca. Studies were conducted on lysosomal enzyme activity in mice injected with ^{119}In. Electron microscope examination of soft tissues revealed accumulations of material within the lysosomal bodies which were thought to be colloidal indium deposits. These demonstrated the obvious increase in information achievable by combining electron microscopy, histochemistry, and quantitative enzyme measurements. The acid glycerophosphatase was localized to the lysosomes in all cells and to the primary lysosomes of the Golgi apparatus within most cells. Activities of lysosomal phosphatases were altered even at low levels of irradiation. It was noted that bone cells from irradiated leukemia mice contained large numbers of virus particles. (H.L.W.)

23999 (SGAE-LA-3/1970) UPTAKE OF ^{64}Cu BY EXCISED PLANT ROOTS FROM NUTRIENT SOLUTIONS. Haunold, E.; Wurst, F. (Oesterreichische Studiengesellschaft fuer Atomenergie, G.m.b.H., Seibersdorf. Landwirtschaftliche Forschungsabt.) Oct 1970. 10p. (CONF-710202-1). Dep. NTIS (U. S. Sales Only).

From International Symposium on Soil Fertility, New Delhi, India.

^{64}Cu uptake by excised roots of barley, beans, and peas was studied using $Cu(NO_3)_2$ and Hoagland-solutions having a Cu-concentration of 3.2×10^{-7} M. Barley roots took up Cu in increasing amounts with an increase in pH from 5 to 7 and a change from $Cu(NO_3)_2$ to Hoagland-solution. Beans and peas that absorbed Cu at a much greater rate than barley were hardly influenced by pH or solution composition. Since Cu uptake was depressed by 2.4-DNP and chloramphenicol, uptake was considered to depend on metabolism being linked to ATP synthesis. (auth)

24000 DETECTION OF ^{90}Sr IN THE WINTER AND SUMMER FEED OF DAIRY CATTLE. Permikina, Z. A.; Yakovleva, Z. P. Veterinariya; 46: 95-7(1969). (In Russian).

In the independent region of Sverdlovsk, the main source of fallout ^{90}Sr in the diet of dairy cattle is the course feed. In the stable, the hay accounts for 67% of the ^{90}Sr while the concentrated fodder accounts for only 1.6%. In the pasture, the grass accounts for 86% while only 14% affects the grass seed. Knowledge of the sources of fallout radioisotopes in the diet of dairy cattle permits control of their admittance to the body of the animal. Controlling the main source of fallout ^{90}Sr in the diet involves a study of all of its components. Knowing the coefficient of transition for the radioisotope from feed to milk, it is possible to forecast its content in the milk. (tr-auth)

24001 EFFECT OF DIABETES ON THE UPTAKE OF RADIOACTIVE SULPHATE INTO CHONDROITIN SULPHATE BY RAT LIVER SOLUBLE ENZYME. Cohen, M. P.; Bluguermann, J.; Foglia, V. G. (Univ. of Buenos Aires). Horm. Metab. Res.; 2: 271-4(Sep 1970).

The uptake of radioactive sulfate into chondroitin sulfate catalyzed by the hepatic enzyme system of normal and pancreatectomized diabetic male rats was examined. It was found that the enzymatic uptake of labeled sulfate into chondroitin sulfate was stimulated with low concentrations (less than 1.0 mg) of soluble enzyme prepared from livers of diabetic rats, whereas high concentrations (greater than 2.0 mg) of diabetic enzyme protein non-competitively inhibited radioactive sulfate uptake. (auth)

24002 PENETRATION OF ^{90}Sr THROUGH PLACENTAL BARRIER IN COWS. Sirotkin, A. N.; Nikitina, Z. A. (All-Union Research Inst. of Physiology and Biochemistry of Farm Live-Stock, Kaluga, USSR). Sel'skokhoz. Biol.; 5: 402-4(1970). (In Russian).

It is shown that the amount of strontium-90 transfer from the mother to an embryo in the course of the first, second, and third pregnancy is increasing, then it decreases to the level typical for calves of the first calving and thereafter remains unchanged. Distribution of strontium in calf skeleton proceeds non uniformly regardless of the number of calvings. (auth)

24003 RADIOACTIVE ESTRADIOL ACCUMULATION IN ENDOMETRIOSIS OF THE RHESUS MONKEY. Eisenfeld, A. J.; Gardner, W. U.; van Wagenen, G. (Yale Univ., New Haven). Amer. J. Obstet. Gynecol.; 109: 124-30(1 Jan 1971).

Tritium-estradiol was administered intravenously to 7 rhesus monkeys and the concentration of radioactivity in tissues measured one or two hours later. Four of the monkeys had endometriosis; in three the disease followed pelvic irradiation several years previously. High concentrations of radioactivity were found in the endometrium, myometrium, endometriosis, and adenomyosis relative to the concentrations in plasma, fat, or muscle. (auth)

24004 ASEPTIC MENINGITIS FOLLOWING THE INTRATHECAL INJECTION OF RADIOIODINATED SERUM ALBUMIN. Oldham, Robert K; Staab, Edward V. (Vanderbilt Univ. Nashville). Radiology; 97: 317-21(Nov 1970).

Two cases of aseptic meningitis following the introduction of 100 μCi of radioiodinated serum albumin (RISA) into the lumbar intrathecal space are presented. Less than 2 mg of albumin was injected in each case. No permanent sequelae were noted. A brief review of the literature dealing with aseptic meningitis and the possible mechanisms of producing this condition are discussed. (auth)

24005 GENETIC EFFECTS OF ATOMIC BOMB EXPLOSION IN NAGASAKI ON SOME CROP PLANTS AND CHROMOSOMAL ANALYSIS OF THE PROGENY LINES. Nagamatsu, T. (Kyushu Univ., Fukuoka). Genet. Agr.; 23: 38-42(Dec 1969).

From 5th Congress of the European Association for Research on Plant Breeding, Milan, Italy. See CONF-680981.

The results on the genetic effects of atomic energy on two plants after 20-yr exposure are presented along with the segregation behavior of the mutated genes. Further experiments were done on chromosome mapping of rice plants, using those with reciprocal translocated lines and trisomic plants. X and γ radiations were used and the effects of high temperature shock and ultracentrifuging were studied. (P.B.M.)

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24006 MASS SCREENING FOR SPECIFIC AMINO ACIDS BY NUCLEAR CHEMICAL, BIOLOGICAL, AND ENZYMATIC TECHNIQUES. Luse, R. A. (International Atomic Energy Agency, Vienna). pp 237-42 of Improving Plant Protein by Nuclear Techniques. Vienna; International Atomic Energy Agency (1970).

From Symposium on Plant Protein Resources: Their Improvement Through the Application of Nuclear Techniques, Vienna, Austria. See STI/PUB-258; CONF-700612.

Techniques by which large numbers of plant lines particularly mutant lines may be analyzed for their protein content and nutritional quality are needed by the plant breeder striving for improved plant protein. For cereals and legumes, screening must involve the determination of total protein content and of the content of those essential amino acids which are present in such low levels as to limit the nutritional value. Such amino acids include lysine, isoleucine, methionine, cystine, and tryptophan. Such screening techniques must be based on sound analytical principles, which implies low variability and good reproducibility of analytical results. Just as important, however, is the feasibility of a technique for mass screening, which must be determined from time cost studies, by which are measured such factors as real cost per analysis, time required per analysis, and ability for handling large numbers of samples. Such feasibility studies now under way were discussed for four techniques: double isotopic labelling and separation by thin layer chromatography of specific amino acids, radioisotopic assay of CO_2 from decarboxylase action on specific amino acids, utilization of a ^{14}C-labelled energy source in the microbiological assay of specific amino acids, and activation of plant nitrogen by 14-MeV neutrons to measure total protein. (auth)

24007 WHOLE-BODY COUNTING OF SOME RADIOACTIVE ISOTOPE AND RADIOPHARMACEUTICAL PRODUCTION WORKERS. Athey III, T. Whit; Killian, Charles; Dugan, Mary Ann; Shleien, Bernard (Bureau of Radiological Health, Winchester, Mass.). Amer. Ind. Hyg. Ass. J.; 31: 711-17(Nov-Dec 1970).

A study was made of individuals employed at a commercial firm which manufactures radioactive isotope labeled pharmaceuticals. Fifty-eight whole-body counts were performed on 30 subjects over a period of one year. Nineteen isotopes were identified in these subjects during the study including: ^{110m}Ag, ^{57}Co, ^{58}Co, ^{60}Co, ^{134}Cs, ^{137}Cs, ^{59}Fe, ^{203}Hg, ^{125}I, ^{131}I, ^{54}Mn, ^{22}Na, ^{125}Sb, ^{46}Sc, ^{75}Se, ^{113}Sn, ^{87}Sr, and ^{65}Zn. Of the radioactive isotope production workers (20 individuals involved in separation, processing, and packaging of radioactive isotopes from irradiated materials), the majority of the subjects showed evidence of a mixture of radionuclides while only four showed no significant elevations. None, however, had more than 15% of the maximum permissible burden at the time of counting. Ten persons involved in production of ^{99m}Tc from a ^{99}Mo generator had as a group much lower whole-body radionuclide burdens than the isotope production workers. (C.H.)

24008 INFLUENCE OF PHOSPHORUS AND NITROGEN NUTRITION ON UPTAKE AND DISTRIBUTION OF STRONTIUM AND CALCIUM IN OAT PLANTS. Andersen, A. J. (Danish Atomic Energy Commission, Risoe). Soil Sci. Soc. Amer., Proc.; 35: 108-11(Jan-Feb 1971).

The influence of phosphorus and nitrogen applications on the uptake of radioactive strontium and calcium by oats (Avena sativa L.) was studied in pot experiments. Heavy applications of phosphorus decreased the concentrations as well as the total uptake of ^{90}Sr and Ca, but the $^{90}Sr/Ca$ ratio was little affected. Nitrogen additions increased the uptake of stable Ca more than that of ^{90}Sr so that the $^{90}Sr/Ca$ ratio based on total uptake decreased with increasing N supply. Nitrogen application increased the total uptake of added ^{90}Sr and ^{45}Ca considerably, but the relative distribution of the two isotopes in grain and straw was affected differently. The concentration of ^{90}Sr in grain decreased with increasing N supply until the maximum yield was obtained. Above this level, additional N caused a parallel increase of the ^{90}Sr and ^{45}Ca concentrations. The results indicated that translocation of Sr and Ca as well as their uptake may be differentially influenced by N nutrition. (auth)

24009 UPTAKE OF ^{65}Zn BY FRESHWATER FISH (EXPERIMENTAL INVESTIGATION). Lebedeva, G. D.; Kuznetsova, G. A. Gig. Sanit.; No. 1, 119-20(Jan 1969). (In Russian).

Zinc-65 activity in tissues of fish was determined using single-crystal scintillation γ-spectroscopy. The statistical mean-square error in measuring samples with activity of 10^{-8} Ci did not exceed 2%, while in samples containing 10^{-10} Ci the error was 19%. After only one day in contaminated water, ^{65}Zn activity was determined in all of the organs and tissues examined. It was found that ^{65}Zn was concentrated primarily in the internal organs, gills, and skeleton, and most of it was retained in the body of the fish for 1½ to 2 months. Subsequently, the ^{65}Zn content of the tissues increased only insignificantly. The lowest concentration was found in muscle tissue, which is used as food. The ^{65}Zn content of the internal organs, gills, and skeleton exceeded that of the muscle tissue by 14, 10, and 3 times respectively. (tr-auth)

24010 RADIOAKTIVNYE IZOTOPY VO VNESHNEI SREDE I ORGANIZME. (Radioisotopes in the External Environment and in Organisms). Moskalev, Yu. I. (ed.). Moscow; Atomizdat (1970). 264p.

The behavior of specific radioisotopes (strontium, cerium, cesium, ruthenium, and tellurium) in the external environment and in the body of animals, the biological activity of ^{90}Sr in the body, and the protective effects of different preparations in relation to the deposition of strontium in the body are considered. Emphasis is placed on studies involving the behavior of ^{90}Sr in the external environment and in the body of agriculturally important animals, and also on the buildup and distribution of dose rates and absorbed doses in growing animals. Studies of the biological effects of ^{90}Sr on growing and adult organisms in relation to the absorbed dose in critical and other organs are prominantly featured. Data on the protective effects of calcium and sodium salts of phytic acid on the deposition of strontium in organisms are given along with the negative effects of the preparations on calcium exchange. Methods for estimating the optimum quantities of the protective preparations are given. The book is for a wide range of specialists working in the areas of radiobiology and radiation hygiene. The bibliography contains 414 citations. (tr-auth)

24011 POSSIBILITIES OF USING NEUTRON-ACTIVATION METHODS IN THE STUDY OF IODINE EXCHANGE IN ORGANISMS. Malenchanka, A. F.; Kazyuk, G. V.; Luchkin, B. R. (Inst. of Nuclear Energy, Minsk). Vestsi Akad. Navuk BSSR, Ser. Biyal. Navuk; No. 4, 94-7(1970). (In Belorussian).

The possibility of using neutron activation methods for the determination of iodine in the thyroid gland, the rules governing iodine distribution in normal thyroidal parenchyma and goitrogenic tissues, and the determination of related proteins under different thyroidal disease conditions were studied. The broad possibilities for the application of neutron activation analysis in clinical investigations are demonstrated. (tr-auth)

24012 ACCUMULATION OF ^{140}Ba AND ^{140}La BY FRESHWATER PLANKTON. Rodionova, L. F.; Sukal'skaya, S. Ya. Gidrobiol. Zh.; 5: No. 6, 87-91(1969). (In Russian).

The accumulation of ^{140}Ba and ^{140}La by the Protococcales (algae) from untreated freshwater in aquariums was most intensive during the first days of the experiment, reaching a maximum value toward the end of 1 to 1.5 days. The coefficient of accumulation, 20000 to 26000, averaged three times less than that for the accumulation of unseparated mixtures of uranium fission products by the algae. The coefficient of accumulation for ^{140}Ba and ^{140}La by the algae, and the reduction of their concentration in the aquarium water, did not depend on the initial concentration of the radioisotopes in the water (3×10^{-4} and 5×10^{-6} kR/l respectively). The Protococcales accumulate ^{140}Ba and ^{140}La from the water to a greater extent than do mixed plankton (coefficient of accumulation 26000 and 8000 respectively). Also, the concentration of the radioisotopes is reduced more quickly by these algae than by mixtures of plankton containing infusoria (paramecium and rotifers) in addition to the algae. (tr-auth)

24013 COMPOSITION OF TRABECULAR BONE IN CHILDREN. Dyson, E. D.; Whitehouse, W. J. (Atomic Energy Research Establishment, Harwell, Eng.). pp 62-5 of Symposium Ossium. /Jelliffe, A. M. (ed.). London; E. and S. Livingstone (1970).

From Symposium ossium; London (4 Apr 1968).

Measurements of the calcium and phosphorus content of trabecular and cortical bone and bone marrow from young children are given. The percentages of calcium and phosphorus in trabecular tissue ash were found to be very similar to those in cortical bone ash. The proportion of bone in trabecular bone tissue is calculated from the calcium content, the phosphorus content and ash weights. It is concluded that only a quarter the weight of trabecular bone tissue is bone. (UK)

24014 THE MODE OF FIXATION OF ^{239}Pu AND ^{241}Am IN BONE: A POSSIBLE EXPLANATION OF THEIR DIFFERENT CARCINOGENICITY. Taylor, D. M.; Chipperfield, A. R. (Inst. of Cancer Research, Sutton, Eng.). pp 215-17 of Symposium Ossium. /Jelliffe, A. M. (ed.). London; E. and S. Livingstone (1970).

From Symposium ossium; London (4 Apr 1968).

The relative affinity of bone mineral for plutonium and americium was compared by measuring the uptake of ^{239}Pu or ^{241}Am by ashed bovine cortical bone as a function of the concentration of citrate in the suspending medium. The binding of americium and plutonium to bone sialoprotein and transferrin in vivo was studied

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by gel filtration. It is suggested that both have a strong affinity for bone mineral, but that under biological conditions, americium will tend to deposit on bone more readily. The binding of plutonium by bone sialoprotein was much stronger than that of americium and both were bound more strongly by sialoprotein than by transferrin. (UK)

24015 CONSUMPTION OF RADIONUCLIDES FROM MILK BY MAN AFTER RADIONUCLIDE CONTAMINATION OF PASTURES: A PREDICTIVE MODEL. Lengemann, F. W. (New York State Veterinary Coll., Ithaca. Cornell Univ., Ithaca, N. Y.). Zentralbl. Veterinaermed., Beih.; No. 11, 77-87(1970).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

A model was developed to make it possible to rapidly determine the health significance of a deposition of ^{137}Cs and ^{131}I on vegetation that will be consumed by grazing dairy cattle. The assessing procedure is based on the observation that the radionuclide content of milk will follow a reasonably predictable function. This in turn suggested that relating the total intake by an average member of the human population over time to the intake on any particular day by means of ratios (F values) could result in eliminating many inaccurate estimates and time consuming measurements. In calculating the F values the amount of radioactivity consumed daily by the cow cancels out of the equation and so it is not necessary to collect and measure forage samples. This paper details the use of F values when dealing with a rapid deposition or a single deposition of a radionuclide extending over a period of time and whose half time of deposition can be determined. Using the basic equations it was possible to estimate the significance of two procedures designed to reduce radionuclide transfer to humans through milk and in addition to provide a means of estimating the total intake of a radionuclide by using pasture levels of radionuclides. (auth)

24016 MONITORING THE RADIOACTIVITY OF ANIMALS AND ANIMAL PRODUCTS. Paakkola, O. (Institut fuer Strahlenphysik, Helsinki). Zentralbl. Veterinaermed., Beih.; No. 11, 88-94(1970). (In German).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

In Scandinavian countries, Denmark, Finland, Iceland, Norway, and Sweden, nutritional habits and diet are very similar. In Iceland and Norway there is a heavy consumption of fish, whereas Finland consumes mostly milk. Results obtained from monitoring radioactivity of animals and foodstuffs of animal origin in Scandinavia are discussed. Estimation of ^{90}Sr and ^{137}Cs shows that their highest values are reached in foods in Norway. A relation between the deposition of ^{90}Sr and ^{137}Cs and their concentration in milk is calculated as well as the total uptake of Sr and Cs in the diet. The highest dose of radiation that was produced by deposition of strontium in the bones is calculated per head and is a few tenths of a rad. The genetic dose lies between about 0.5% and 5% of the mean natural background dose. (auth)

24017 ^{131}I IN THYROIDS OF CATTLE AND SHEEP OF PORTUGAL. Simoes, Jose Henriques; Teixeira, Manuel Ribau (Estacao Agronomica Nacional, Sacavem, Portugal. Laboratorio de Fisica e Engenharia Nucleares, Sacavem, Portugal). Zentralbl. Veterinaermed., Beih.; No. 11, 101-9(1970).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

After the third Chinese nuclear weapon test, a survey was conducted on ^{131}I in thyroids of pasture-fed livestock from the Portuguese Mainland and the Azores Islands. Samples of 100 g of thyroid tissue were counted by gamma spectrometry. The following observations were made: higher specific activities in sheep than in cattle glands; first noticeable detection of ^{131}I after the Chinese weapons tests was 14 days after the 3rd and 5th, 11 days after the 4th and 9 days after the 7th. After the sixth test, the first thermonuclear one, no noticeable radioactivity increase in the glands was observed. A rough appreciation of the graphics shows: an extension of the ascending slope of 12 to 14 days, an extension of the plateau of 14 to 17 days, an effective half-life of about 20 days, and an extension of the descending slope of 50 to 60 days. (auth)

24018 STUDIES ON THE DISTRIBUTION OF ^{137}Cs IN ABATTOIR CATTLE. Schroeder, K.; Kotter, L.; Kreuzer, W.; Kuenzl, R.; Lugmayr, D. (Univ., Munich). Zentralbl. Veterinaermed., Beih.; No. 11, 110-15(1970). (In German).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

Various portions of muscles and organs (heart, spleen, kidney) of bulls were examined for ^{137}Cs and the mean values were determined for homogeneous and random groups. Differences in ^{137}Cs contamination of individual groups of samples were also tested for significance by the Duncan test. Certain differences in ^{137}Cs content occurred between muscle and organ material. Of the muscle samples from the upper thigh, upper neck, back and flank, samples from the flank usually showed the highest mean activity; but differences from the back muscle were not always significant. Among the organs, kidneys were the most contaminated, followed by heart and spleen. In general, the distribution of ^{137}Cs in naturally-contaminated bulls is very comparable to that in long-term artificial contamination. For routine studies on carcase material for ^{137}Cs contamination, the most suitable samples are from the upper thigh or back muscles or similar areas; in this way the most highly contaminated areas are likely to be included. (auth)

24019 RADIOMETRIC DISSECTION OF CATTLE. AN ACCOUNT OF THE LIMITATION OF THE TECHNIQUE. Pfau, A.; Salem, M. A. I. (Max-Planck-Institut fuer Tierzucht und Tierernaehrung, Mariensee/Trenthorst, Ger.). Zentralbl. Veterinaermed., Beih.; No. 11, 121-30(1970). (In German).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

In a model experiment an attempt was made to determine whether the short-lived radionuclides ^{42}K and ^{24}Na can be used for a dilution analysis for the purpose of radiometric dissection. This is based on the assumption that the amount absorbed by the body is the smallest possible, while the levels in serum, urine, and feces are as high as possible and the residual activity in the carcass at slaughter is negligibly small compared with the natural radioactivity. Results show that with a combined NaI measurement and a relatively small injection activity it is possible to fulfill these conditions in bulls weighing about 540 kg in the case of ^{24}Na in urine, feces, and serum. In the case of ^{42}K it applies to urine and feces only; serum can be measured by this method only when it is above the more sensitive Cérenkov effect. (auth)

24020 DISTRIBUTION OF ^{90}Sr IN THE SUCKING RAT. Kollmer, W. E. Zentralbl. Veterinaermed., Beih.; No. 11, 181-4 (1970). (In German).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

The excretion of ^{90}Sr, including secretion in the milk, is increased in the lactating rat. When the nuclide is given 10 days post-partum, increased excretion is greater than when it is given on the first day of lactation. Under these conditions the amount taken up by the young rats in the milk in the course of 48 hours may be more than half the total amount excreted by the mothers. Later than 48 hours after dosing, the radioactivity of the young animals increases only slightly. The excretion rate of the mothers is then practically the same as that of control unmated animals. (auth)

24021 COMPARATIVE STUDIES ON ^{137}Cs ELIMINATION BY VARIOUS IRON HEXACYANOFERRATE COMPLEXES IN THE RAT. Giese, W.; Hantzsch, D. (Tieraerztliche Hochschule, Hanover). Zentralbl. Veterinaermed., Beih.; No. 11, 185-90 (1970). (In German).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

Excretion of ^{137}Cs from the gut before resorption is very important for reducing radiation damage to the animal. Alkaline iron cyanide complexes of the type $Me\ Fe^{III}\ Fe^{II}\ (CN)_6$ were used in experiments on rats. After 24 hours there were high fecal and renal excretion rates. The effect of the relatively insoluble and non-absorbed complex was associated with the exchangability of the alkaline ions with the radiocesium ion and the formation of an insoluble cesium compound. In particular, the cheap substance $NH_4\ Fe^{III}\ Fe^{II}\ (CN)_6$ can be recommended as an addition to the food of domestic animals for its marked ability to cause the elimination of ^{137}Cs. (auth)

24022 QUESTION OF BIOLOGICAL DECONTAMINATION OF HIGHLY RADIOACTIVE MILK GIVEN TO PIGS. 1. THE BEHAVIOUR OF ^{137}Cs AFTER DAILY DOSAGE AND UNDER SPECIFIC FEEDING CONDITIONS. Giese, W.; Schanzel, H.; Hill, H. (Tieraerztliche Hochschule, Hanover). Zentralbl. Veterinaermed., Beih.; No. 11, 191-7(1970). (In German).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

Four castrated pigs were given ^{137}Cs for 35 days at a level of 2.4 μCi daily, half in a litre of milk morning and evening. Two animals received at the same time $KFeFe(CN)_6$, also in the milk and at a level of 5.6 g/l for the first 20 days and 8.0 g/l for the remaining 15 days. Two control pigs received no $KFeFe(CN)_6$. Feces and urine were collected for 300 days and examined daily by gamma spectroscopy. Whereas urinary excretion predominated in the control pigs, feeding $KFeFe(CN)_6$ resulted in almost 100% of the ^{137}Cs being excreted in the feces. When dosage ceased, the fecal excretion fell off rapidly. Because of the reduced retention the total excretion of ^{137}Cs in treated animals on the 40th day was 2.2% of the daily dose, whereas in the control animals it was 15 times higher. (auth)

24023 AUTORADIOGRAPHIC STUDIES ON THE CELLULAR PARTITION OF ^{134}Cs IN THE ORGANS OF RATS. Giese, W.; Rekowski, C. (Tieraerztliche Hochschule, Hanover). Zentralbl. Veterinaermed., Beih.: No. 11, 198-205(1970). (In German).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

Five male Wistar rats were given oral doses of 11 μCi ^{134}Cs-Cl/100g body weight and the cellular and to some extent the subcellular partitions of radiocesium were determined by autoradiography of heart, liver, kidney, skeletal muscle, lung, spleen, stomach, intestine, and testes. The results showed that marked differences exist in the deposition of ^{134}Cs in, especially, the skeletal muscle, heart, kidney, and spleen. Particularly striking were collections of silver granules on the skeletal muscle fibres, located especially about the cross striations. The demonstration of silver granules over the nuclei suggests that radiocesium is either incorporated into the nuclei or is fixed to the nuclear membrane. (auth)

24024 INCORPORATION AND RATE OF EXCRETION OF RADIOACTIVE MANGANESE IN FATTENING CHICKS. Akkilic, M.; Loercher, K. (Freie Univ., Berlin). Zentralbl. Veterinaermed., Beih.: No. 11, 272-8(1970). (In German).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

Using 98 chicks ranging in age from three to six weeks, the rate of incorporation and excretion of ^{54}Mn was measured in liver and skeleton after 2 to 6 days, and in younger animals after 9 and 13 days, following 24-hour administration of food containing ^{54}Mn. The diet consisted of maize–milo–soya containing 15 ppM Mn with the addition of manganese sulphate or manganese sulphate labeled with ^{54}Mn. The effect of EDTA in a dosage of 0.2% on these criteria was also studied. Up to the 48th hour after administration fecal ^{54}Mn excretion revealed an approximate ^{54}Mn retention of between 5 and 10%. Birds with 30 ppM Mn in the ration incorporated into their liver and skeleton significantly more ^{54}Mn than chicks given 120 ppM Mn. Adding 0.2% EDTA to the ration produced in the three-week-old birds an increase in ^{54}Mn deposition only at low Mn levels, whereas in the older chicks the same occurred after feeding 120 ppM. In absolute terms, the Mn content of the liver and skeleton derived from the labeled ration was as high in birds given 30 ppM Mn together with EDTA as in the chicks given 120 ppM Mn without EDTA. Increased uptake is usually dependent upon a more rapid removal from the body. The results are discussed in relation to their practical significance in animal nutrition with special reference to incorporation of radioactive Mn. (auth)

24025 DISTRIBUTION OF ^{54}Mn IN THE FOWL. Schmidt, H.; Schroeder, K.; Kreuzer, W. (Univ., Munich). Zentralbl. Veterinaermed., Beih.: No. 11, 279-82(1970). (In German).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

Twenty-nine four-month-old cockerels of a White Leghorn Hyline strain were given orally a single dose of 103 nCi per kg bodyweight of a carrier-free ^{54}Mn nitrate solution. During the experimental period of 57 days the alimentary tract, skin, internal organs, bones, and muscles were examined for uptake, distribution, and excretion of ^{54}Mn at 17 different times. Six percent of the ^{54}Mn activity could be recovered from the carcass one day after its administration. The highest levels of ^{54}Mn were found in the internal organs and alimentary tract during the first days after dosing. At the end of the experimental period, on the other hand, the highest levels were in bones and muscles. (auth)

24026 MIGRATION OF ^{90}Sr IN THE BIOLOGICAL CHAIN AND POSSIBILITIES OF ITS REDUCTION IN THE LATTER. THE RESULTS OF OBSERVATIONS ON CULTIVATED PLANTS AND ANIMALS. Korneev, N. A.; Burov, N. I.; Sirotkin, A. N.; Nikolaeva, E. M.; Panchenko, I. Ya. (Inst. of Biophysics, Moscow). Zh. Obshch. Biol.; 31: 690-7(Nov-Dec 1970). (In Russian).

The highest incorporation of ^{90}Sr in plants of natural meadows was observed when ^{90}Sr was found in the surface soil. The displacement of ^{90}Sr down to a depth of 25 cm reduced its incorporation per plant weight unit 2 to 125 times and per 1 g Ca (Sr units) 2 to 17 times. The displacement of ^{90}Sr down to a depth of 30 to 40 cm reduced its incorporation still more by 1.5 to 2 times. The level of ^{90}Sr uptake by animals from food was related to age, functional state of the organism, and amount of Ca in the rations. The absorption of ^{90}Sr in blood was much higher in young animals as compared with adults. The absorption of ^{90}Sr before and during egg laying in hens was 40 to 80% of the amount injected and decreased to 24 to 26% in the period between egg layings. An increased Ca content in the rations lowered the uptake of ^{90}Sr in animals, their progeny, and milk. A possibility is open to restrict the incorporation of ^{90}Sr in individual links of the biological chain: soil–plant–animals–food of animal origin. (auth)

24027 BEAGLE AS AN EXPERIMENTAL DOG. Andersen, Allen C. (ed.). Ames, Iowa; Iowa State University Press (1970). 626p. $17.50. (TID-25530).

Separate abstracts were prepared for 2 chapters dealing with the retention of radionuclides and with whole-body counting. Other chapters contain information on husbandry, anatomy and physiology, and techniques for studying the beagle. (P.B.M.)

For abstracts of individual chapters see: 24028 and 24029.

24028 RADIONUCLIDE METABOLISM. Richmond, Chester R.; Furchner, John E. (Los Alamos Scientific Lab., N. Mex.). pp 479-88 of Beagle as an Experimental Dog. /Andersen, Allen C. (ed.). Ames, Iowa; Iowa State University Press (1970). See TID-25530.

Studies were done on radioisotope retention in Beagle dogs. Data were obtained by administering tracer amounts of radionuclides to beagles via the oral or parenteral route. The radioisotopes examined were rubidium-86, cesium-137, beryllium-7, barium-133, and zinc-65. (P.B.M.)

24029 WHOLE-BODY COUNTING. Richmond, Chester R.; Furchner, John E. (Los Alamos Scientific Lab., N. Mex.). pp 588-93 of Beagle as an Experimental Dog. /Andersen, Allen C. (ed.). Ames, Iowa; Iowa State University Press (1970). See TID-25530.

Whole-body counting as applied to beagles is described. The advantages of whole-body counting over other methods are pointed out. NaI(Tl) crystal detectors and 4π geometry liquid scintillation counters are usually used to measure γ rays, but measurement of bremsstrahlung from beagles is also possible. Biological models used for describing whole-body retention kinetics are discussed. (14 references) (R.W.R.)

24030 WHOLE-BODY RETENTION AND HAND UPTAKE OF ^{47}Ca. STUDIES IN HEALTHY SUBJECTS, ASTHMATIC PATIENTS TREATED WITH GLUCOCORTICOIDS, AND PARTIALLY GASTRECTOMIZED PATIENTS. Bergqvist, Eva. Stockholm: Karolinska Mediko-Kirurgiska Institutet (1970). 88p. Karolinska Inst., Stockholm.

Thesis.

Whole-body retention of orally administered ^{47}Ca was measured in a whole-body counter in healthy subjects, asthmatic patients on glucocorticoid therapy, and partially gastrectomized patients. As a standard procedure ^{47}Ca was administered in 50 mg of calcium as $CaCl_2$. Calcium supplementation was given in tablets, 2 g Ca/day for four days before the administration of the isotope and for 10 days afterwards. Hand uptake of intravenously injected ^{47}Ca was measured between the crystals of the whole-body counter at 10, 60, and 240 min after the injection in the same groups of subjects. The following observations were made. A constant diet does not seem to be necessary in studies of whole-body retention of orally administered radiocalcium. A high calcium intake gave a decrease in whole-body retention of orally administered ^{47}Ca, possibly due to a suppression in parathyroid activity. Whole-body retention of orally administered ^{47}Ca did not change with age in adult subjects. Hand uptake of intravenously injected ^{47}Ca increased with increasing age in healthy subjects. Asthmatic patients on continuous glucocorticoid therapy had slightly reduced 14-day retention of orally administered ^{47}Ca. The difference from normal values was not significant, however, hand uptake of intravenously injected ^{47}Ca was normal. Patients studied after Billroth II operation had significantly increased whole-body retention of orally administered ^{47}Ca. Retention of ^{47}Ca given in milk and food was within normal limits. Long-term treatment with calcium tablets normalized whole-body retention of orally administered ^{47}Ca. These findings are interpreted as evidence of an increased intestinal absorption of radiocalcium given in an easily soluble calcium salt, probably due to a secondary hyperthyroidism. Hand uptake of intravenously injected ^{47}Ca was normal. Patients studied after Billroth I operation combined with total abdominal vagotomy

had normal whole-body retention of orally administered ^{47}Ca and normal hand uptake of intravenously injected ^{47}Ca. (auth) (Sweden)

24031 MATHEMATICAL FUNCTIONS TO FACILITATE CALCULATION OF THE SYSTEMATIC RETENTION AND EXCRETION IN URINE OF SLIGHTLY SOLUBLE RADIOACTIVE COMPOSITIONS AFTER INHALATION. Breuer, F. (CNEN, Rome). Minerva Fisiconucl.; 12: 155-62(Jul-Sep 1968). (In Italian). (RT/PROT-(69)8).

In cases of the acute assimilation of radioelements, the time course for whole-body retention and for excretion are described as exponential functions, or as the sum of exponentials, or as a power function, or as the sum of an exponential function and a power function. When slightly soluble material is introduced acutely by inhalation, the material is transferred from the lung region following a time course represented by a sum of exponentials, while resolution of the problem of calculating whole-body retention and excretion in the inhalation of slightly soluble materials requires a combination of exponential functions with exponentials or a combination of exponential functions with power functions. In the present work, a method is set forth for accomplishing the combination of exponential functions with power functions by using a particular function calculated from an infinite power series. Tables and graphs of the function and a practical example for calculation referring to ^{235}U are included. (tr-auth)

24032 STUDIES ON THE TISSUE DISTRIBUTION OF ^{125}I-IODOPROPAMIDE IN THE DOG. Boyd, C. M.; Holcomb, G. N.; Counsell, R. E.; Beierwaltes, W. H.; Lieberman, L. M. (Univ. of Michigan, Ann Arbor). J. Nucl. Med.; 12: 117-18(Mar 1971).

A study was made on the localization of ^{125}I-iodopropamide in the pancreas of dogs to evaluate its effectiveness as a scanning agent. The maximum radioactivity from ^{125}I-iodopropamide in percent dose/gram of tissue in the pancreas was slightly less than in the liver. The concentration in the islet cells as compared to adjacent acinar cells in the pancreas was high although the total amount present in the pancreas was low. If a patient had a neoplasm of the pancreas consisting of a large enough mass of functioning islet cells, the neoplasm might be detected by scanning using this compound. (E.E.H.)

24033 KINETICS OF DISTRIBUTION AND EXCRETION OF RADIUM ISOTOPES AFTER INJECTION OF THOROTRAST INTO BLOOD. Kaul, A. (Freie Univ., Berlin); Heyder, J. Biophysik; 7: 74-84(1970). (In German).

For reasons of dosimetry a compartment system was developed to study the kinetics of ^{228}Ra and ^{224}Ra in marrow free skeleton and organs of the RES and in the remaining intra- and extracellular space. The concept was based on the following processes: translocation of ^{228}Ra in ionic form of the skeleton; elimination of ^{228}Ra from the skeleton to the intra- and extracellular space, and excretion of ^{228}Ra from the organism; direct excretion of that fraction of ^{228}Ra in ionic form, which was not translocated to the skeleton; excretion of ^{228}Ra with the particle fraction (colloidal fraction); continuous formation of ^{224}Ra in the RES by decay of ^{228}Th and translocation of a constant fraction to the marrow-free skeleton; decay of that fraction, and of ^{224}Ra in the skeleton which was translocated to the skeleton in ionic form at the time of injection of thorotrast into blood; continuous elimination of ^{224}Ra from the skeleton to the intra- and extracellular space, and excretion from the body; continuous excretion of that fraction of ^{224}Ra in ionic form, which was formed by decay of ^{228}Th in the RES, and which was not translocated to the skeleton; and elimination of ^{224}Ra fixed to the particle fraction which was incorporated at the time of injection of thorotrast into blood. Variation by computer analysis of parameters, such as total skeletal retention and half-life of radium for its excretion from the body, revealed excretion curves, which agreed with those measured in animal experiments (rabbits). (auth)

24034 EXCRETION OF RADIOACTIVE ^{210}Po WITH URINE IN MINERS FROM CZECHOSLOVAK URANIUM MINES. Hoelgye, Z. (Inst. of Occupational Hygiene in Uranium Industry, Pribram, Czech.). Cas. Lek. Cesk.; 108: 1450-5(21 Nov 1969). (In Czech).

Three groups of miners were investigated. In the first, second, and third group, the miners had been working for 11.1, 2.4, and 4.8 years, respectively in environments containing Rn in concentrations of 0.82×10^{-10}, 3.07×10^{-10}, and 4.2×10^{-10} Ci/l, respectively. Calculations of polonium levels in urine were made based on the following assumptions: for each man the average radon concentration is known; the minute respiration volume is 20 l; decay products of radon exist in an equilibrium of 35%; 40% of these products is retained in lungs; in lungs the products disintegrate to RaD; the biological and the effective half-live of ^{210}Pb is 990 and 88 days; daily 0.13% of the total polonium load is eliminated with urine; no ^{210}Bi losses occur by elimination in urine and feces; about 40% of lead deposited in lungs appears in blood. According to theoretical calculations, in the three groups 4.9, 16.8, and 29.4% of the found polonium was formed from radon and its decay products. It was assumed that a certain portion of polonium in urine has its origin in dust containing ^{210}Pb, ^{210}Bi, and ^{210}Po. In the groups of interest, 58, 56, and 44% of urine Po may be attributed to dust in the mine. (NSA of Czech)

24035 EXPRESS METHOD OF DETERMINING THE CIRCULATING BLOOD VOLUME WITH THE AID OF RADIOIODINE-LABELLED ALBUMIN. Malov, G. A. (Inst. of Cardiovascular Surgery, Moscow). Med. Radiol.; 15: No. 11, 31-4(Nov 1970). (In Russian).

A method for determining the volume of circulation blood without preliminary determination of the hematocrit is given. A correction coefficient is given for determining the circulating blood volume by the reactivity of whole blood in the use of radioiodine-labeled albumin indicator. (auth)

24036 TISSUE DISTRIBUTION AND DOSIMETRY OF ^{144}Ce IN CHINESE HAMSTERS. Sturbaum, Barbara; Brooks, A. L.; McClellan, R. O. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Contract AT(29-2)-1013. Radiat. Res.; 44: 359-67(Nov 1970).

The tissue distribution, retention, and dosimetry of ^{144}Ce were studied in the Chinese hamster following intraperitoneal injection or inhalation. The body burden of the hamsters that inhaled $^{144}CeCl_3$ decreased to 20% of the initial body burden in the first week post-inhalation exposure, presumably due to clearance of ^{144}Ce from the upper respiratory tract. With time post-inhalation, the percentage of the sacrifice body burden in the lung decreased, and the percentage in the liver and skeleton increased. The ^{144}Ce was retained more tenaciously following intraperitoneal injection. After about 10 days of biological clearance, 60 to 80% of the injected radioactive cerium was still retained. At later times the whole-body burden decreased with an effective half-life nearly equal to the physical half-life of the isotope. Ultimately, the sacrifice body burdens of ^{144}Ce were 70 and 30%, respectively, in liver and skeleton, regardless of the route of administration. For the inhalation-exposed hamsters, the highest cumulative radiation dose to 256 days post-^{144}Ce inhalation was received by the lung, followed by liver, then skeleton. The total cumulative radiation doses to 900 days post-^{144}Ce administration were estimated for lung, liver, and skeleton, respectively, to be 12,000, 15,000, and 1400 rads/μCi initially deposited per gram body weight. For the animals that received ^{144}Ce by intraperitoneal injection, the cumulative radiation dose to liver exceeded that to skeleton at all times with the cumulative radiation dose to 900 days post-^{144}Ce administration for liver and skeleton estimated at 110,000 and 13,000 rads, respectively. (auth)

24037 INHALATION OF A $^{24}Na_2CO_3$ AEROSOL. Halik, J. (Inst. of Hygiene, Epidemiology, and Microbiology, Prague). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 81-6(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

The deposition and retention of ^{24}Na after inhalation of soluble Na_2CO_3 was studied in rats. It was found that within 10 min after inhalation most of the activity was deposited in the respiratory tract, with the maximum in the nasopharynx, then in the lungs and in the trachea. Two hr after inhalation more activity was found in the parenchyma tissue than in the respiratory tract. Sodium-24 was cleared from the respiratory tract by way of the blood and gastrointestinal tract with the uptake in blood being five times greater. The radioisotope was eliminated in the urine and feces. Within six days, 185% of the inhaled activity was eliminated and the remainder was distributed throughout the entire organism. (F.M.M.)

24038 EFFECT OF LIGHT REGIMEN ON THE HEMOPOIETIC ACTIVITY IN THE MOUSE SPLEEN. Vacek, A.; Rotkovska, D.; Rakova, A. (Inst. of Biophysics, Brno). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 255-60(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

Male mice were adapted for 14 days to various light regimens, including light 12 hr and dark 12 hr, total light, total darkness, and light for 13 hr. The hemopoietic activity of the spleen and femur was estimated from the percent of ^{59}Fe incorporated in 100 mg of wet weight of the spleen and the femur. The values for ^{59}Fe uptake in the femur reached the same level and did not display any changes throughout the entire period for all groups. The results on the spleen indicated circadian rhythm in ^{59}Fe incorporation. Changes in the lighting regiment caused a shift in the ^{59}Fe incorporation. In the group adapted to dark, the percent of ^{59}Fe incorporation was lower than in mice kept in constant light. (P.C.H.)

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Refer also to abstracts 24308, 24421, and 24476.

24039 (AEC-tr-7193) RADIOBIOLOGY. Translation of Radiobiologiya; 10: No. 3, 323-480(1970). 249p. Dep. NTIS.

Abstracts of all 33 of the papers appearing in this cover-to-cover translation were prepared previously from advanced translations of author abstracts in the original language journal. These abstracts appear in NSA under the following volume and abstract numbers: Vol 24: 50697, 50732-50740, 50782, 50829-50831, 50955-50957, 51052-51055, 51100, 51101, 51107-51110, and in Vol 25: 593, 11281-11283, 11314, and 19031. (E.R.B.)

24040 (STI/PUB-258) IMPROVING PLANT PROTEIN BY NUCLEAR TECHNIQUES. Proceedings Series. Proceedings of a Symposium Held in Vienna, 8-12 June 1970. (International Atomic Energy Agency, Vienna (Austria)). Sep 1970. 469p. (In several languages). (CONF-700612). IAEA $12.00.

Forty-three papers are included under the general topics: international development of protein resources, utilization of the world protein, role of induced mutations, nuclear techniques and proteins, determining nutritional value, tracer studies of environmental effects, and physiological and biochemical aspects of protein production. A separate abstract was prepared for each of 14 papers within the subject scope of NSA. Abstracts of two papers appeared previously. (D.E.B.)

For abstracts of individual papers see: 24006, 24042-24044, and 24102-24111.

24041 (UCSF-10-P-2-129) REPAIR OF DAMAGED DNA IN HUMAN AND OTHER EUKARYOTIC CELLS. Cleaver, J. E. (California Univ., San Francisco. Lab. of Radiobiology). [1971]. Contract AT(11-1)-Gen-10. 25p. Dep. NTIS.

Experimental work was carried out on fibroblasts from human skin biopsies of the hereditary disease, xeroderma pigmentosum. The following aspects of excision repair of uv-damaged DNA from xeroderma pigmentosum cell cultures were studied: tissue culture characteristics of fibroblasts; tests for excision repair; sensitivity of xeroderma pigmentosum cells to uv; host cell reactivation of uv-damaged viruses; excision of pyrimidine dimers from human cells; insertion of new bases to repair DNA; repair replication; non-semiconservative replication in unirradiated cells; size of patch made by repair replication after uv; site of enzymatic defect in xeroderma pigmentosum; and repair levels in xeroderma pigmentosum heterozygotes. Repair replication studies on non-human mammalian cells are reported for cells of hamsters, mice, rabbits, marsupials, and cattle. It was concluded that mammalian cells have a repair pathway similar to excision repair in bacteria but only in human cells is the pathway similar in all respects. It is suggested that unrepaired alterations in DNA that lead to increased mutations or increased oncogenic viral transformation may be the most readily testable hypothesis for actinic carcinogenesis in xeroderma pigmentosum. (H.L.W.)

24042 PROTEIN CONTENT OF DIFFERENT VARIETIES OF FIVE SPECIES OF PULSE CROPS. Amirshahi, M. C.; Tavakoli, M. (Univ. of Teheran). pp 331-5 of Improving Plant Protein by Nuclear Techniques. Vienna; International Atomic Energy Agency (1970).

From Symposium on Plant Protein Resources: Their Improvement Through the Application of Nuclear Techniques, Vienna, Austria. See STI/PUB-258; CONF-700612.

The main pulse crops are beans, mungbeans, cowpeas, chickpeas, and lentils and these are the main sources of plant protein. The results show that different varieties of each of the pulse crops vary a great deal in their protein content. Two methods of analysis were used, one the usual Kjeldahl method and the other a colorimetric method with the UD analyser Model S. The results show that the protein content in irradiated lines was increased by 6.61 and 10.17%. (auth)

24043 PROTEIN SYNTHESIS IN IRRADIATED ACETABULARIA AND PHASEOLUS. Kirchmann, R. J.; Bonotto, S. (CENSCK, Mol, Belg.). pp 411-18 of Improving Plant Protein by Nuclear Techniques. Vienna; International Atomic Energy Agency (1970).

From Symposium on Plant Protein Resources: Their Improvement Through the Application of Nuclear Techniques, Vienna, Austria. See STI/PUB-258; CONF-700612.

A unicellular marine alga, Acetabularia mediterranea Lam., and a higher plant, Phaseolus vulgaris L., were used to study the effects of ^{60}Co γ radiations on protein synthesis. With a labelled amino acid (^{3}H-leucine) and adequate biochemical techniques, it was easy to determine the extent to which γ radiations affect protein synthesis. It was found that a dose of 12 krad, which strongly inhibits chlorophyll accumulation in the primary leaves of Phaseolus, has little or no effect on the incorporation of ^{3}H-leucine into the proteins, Similarly, in Acetabularia, even doses which completely stop cellular differentiation (125 to 200 krad) had only a slight effect on protein synthesis. Parallel experiments showed that in both Phaseolus and Acetabularia, γ radiations diminish very strongly the incoporation of ^{3}H 5 uridine into the RNA. Further, it was demonstrated that, in the irradiated Acetabularia cells, the synthesis of DNA and of new ribosomes takes place only at a very low rate. In Phaseolus and in Acetabularia protein synthesis can continue after the irradiation because of the presence in the cells of relatively long-lived messenger RNS (m-RNA). These m-RNA's, which display a high radioresistance, are probably protected in a protein RNA complex. In Acetabularia γ radiations inhibit the synthesis of new ribosomes, still allowing a normal incorporation of ^{3}H-leucine, suggests that protein synthesis must take place on pre-existing ribosomes. Results draw attention to an often neglected but very important fact: stored genetical information (long-lived m-RNA's or an "informational" DNA) can assure the synthesis of proteins and probably of some specific enzymes in the irradiated plant cell, thus allowing eventual repair of the radioinduced damage. (auth)

24044 EFFECTS OF ^{60}Co GAMMA RADIATION ON THE PROTEIN CONTENT OF WHEAT (TRITICUM VULGARE). Lopez Martinez de Alva, L. (Comision Nacional de Energia Nuclear, Mexico City). pp 419-29 of Improving Plant Protein by Nuclear Techniques. Vienna; International Atomic Energy Agency (1970). (In Spanish).

From Symposium on Plant Protein Resources: Their Improvement Through the Application of Nuclear Techniques, Vienna, Austria. See STI/PUB-258; CONF-700612.

To study the qualitative and quantitative effects of ^{60}Co γ radiation on the yield, protein production, baking qualities and weight per hectolitre of wheat, two varieties of Mexican wheat were irradiated and grown under field conditions. The doses selected (13 per experiment) ranged between 0 and 35,000 rad and were distributed at random over various experimental blocks with four replications. The normal fertilization, irrigation, and cultivation practices were followed. The results, both field and laboratory, were subjected to variation analysis, showing highly significant differences in yield as between the various treatments. Increases of yield of up to 17% in comparison with the controls were obtained at irradiation doses between 500 and 4500 rad. There was also an increase in the protein content of the grain, likewise with important differences between treatments, an increase of 31.9% of protein over the control (initial content 9.4%) being obtained with the treatments at 35 rad (content 12.4%). On the other hand, the weight per hectolitre showed a tendency to decrease with increasing radiation dose. (auth)

24045 INDUCTION OF DNA POLYMERASE ACTIVITY IN IRRADIATED TETRAHYMENA CELLS. Keiding, J.; Westergaard, O. (Carlsberg Foundation, Copenhagen). Exp. Cell Res.; 64: 317-22(Feb 1971).

Irradiation of Tetrahymena with sublethal doses of uv light or electrons produced a several fold increase in the specific activity of the total DNA polymerase. The increase continued as long as the cell divisions were blocked after irradiation; thereafter, the specific activity declined towards the level before irradiation. The induction of the enzyme was dependent on RNA and protein synthesis. The induction of the DNA polymerase took place in the period with the most extensive excision-repair of DNA. The results gave further support to the previously proposed hypothesis that induction represents de novo synthesis of a DNA polymerase that is involved in repair of DNA. (auth)

24046 STRUKTURNO-METABOLICHESKAYA GIPOTEZA V RADIOBIOLOGII. (Structural Metabolic Hypothesis in Radiobiology). Kuzin, A. M. Moscow; Izdatel'stvo Nauka (1970). 224p.

The history of the development of the structural metabolic relation in radiobiology is presented; and much is said about the structural metabolic shift in the nuclei of irradiated cells, the dynamics of its origin, and the role of genetic damage (structural and functional). The structural metabolic shifts in the cytoplasm of mitochondria, lysosomes, ribosomes, and membranes are examined. The formation of primary radiotoxins is substantiated, and their contribution to the development of cellular radiation injury is determined. The book concludes with a consideration of the questions of radiosensitivity, protection, and repair in relation to the structural metabolic hypothesis. The book is designed for use by scientific personnel, post graduate students, physicians, and advanced students interested in the problems of radiobiology and related disciplines. (tr-auth)

24047 INFLUENCE OF WHOLE-BODY X IRRADIATION ON THE EXCRETION OF ACID-SOLUBLE DEOXYRIBOSE-CON-

XUM

TAINING COMPOUNDS, PROTEINS, AND ELECTROLYTES IN THE RAT. Neufang, R.; Tempel, K.; Zipf, K. (Univ., Munich). Zentralbl. Veterinaermed., Beih.; No. 11, 56-63(1970). (In German).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

During the first 24 hours after whole-body irradiation of rats with 73 to 975 R, acid-soluble deoxyribose-containing compounds were increased in the urine in proportion to the x-ray dose. Excretion in the urine of biuret-positive material under the same conditions was increased for 28 days and was inversely proportional to the dose. Maximal values occurred on the third and seventh days after irradiation. With a relative dose-proportional advantage in favor of K, there was an increased excretion in the urine of Na, K, and Cl throughout the whole experimental period. Excretory maxima in rats not loaded with water occurred at 24 hours and 7 to 14 days, whereas in shorter experiments with water loading the maxima occurred on the third day after irradiation. The extent of electrolyte excretion was in general inversely proportional to the amount of radiation. The causes of these changes were considered to be mainly extra-renal radiation damage. (auth)

24048 RELATIONSHIP OF DNASES TO IRRADIATION OF NUCLEI. Tempel, K. (Univ., Munich). Zentralbl. Veterinaermed., Beih.; No. 11, 64-9(1970). (In German).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

A comparison of DNase II activity, DNA and acid-soluble DNA-containing compounds in the lymphatic organs (thymus) of rats was studied after whole-body irradiation with sublethal and lethal doses. Also studied was the appearance of DNA compounds in serum and urine under similar conditions, with morphological and biochemical reaction of thymocytes and lymphocytes in vitro after irradiation and also in vivo, with the following results: Permeability damage to the nuclear membrane is of causal significance for the "inter-phase death" of irradiated lymphocytes and thymocytes. The DNA compounds are DNA precursors and DNA breakdown products. The former mirror the inhibition of DNase synthesis, while the latter are the result of non-enzymic and enzymic breakdown. Breakdown of DNA by DNase I begins almost immediately after absorption of the radiation by the tissues and increases with the development of radiation damage. DNA breakdown by DNase II is secondary and represents the regeneration factor accompanying necrolytic processes. (auth)

24049 EFFECT OF X IRRADIATION ON THE BLOOD BRAIN BARRIER (BBB). Roessner, W. (Univ., Munich). Zentralbl. Veterinaermed., Beih.; No. 11, 70-6(1970). (In German).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

Irradiation with x rays increases the permeability of the BBB for Evans blue after a latent period that is dependent on dose. The damage to permeability is maximal on the third day after lethal whole-body irradiation and on the 7th day after a sub-lethal dose. The regenerative process in the BBB after sub-lethal whole-body irradiation takes at least three weeks and there is a return to normal permeability after six weeks. The increased permeability of the BBB for the dye during whole-body irradiation with a lethal dose is reversible and can be seen as a primary effect of the radiation in contrast to subsequent effects. Experiments were carried out with rats. (auth)

24050 DNA STRAND SCISSION AND REJOINING IN IRRADIATED CELLS. Tsuboi, Atsushi (National Inst. of Radiological Sciences, Chiba, Japan). Tanpakushitsu Kakusan Koso; 15: 818-25(Jul 1970). (In Japanese).

The importance of DNA as a target for irradiation death of cells, mechanisms of DNA damage by irradiation, and especially the severance and rejoining of DNA strands are discussed. Severance of DNA strand in mammalian cells by irradiation is difficult to detect at the lethal dose but the scission of double-stranded DNA is probably related to irradiation death of the cells, considering the examples of phage and bacteria. With the development of a method for extraction of double-stranded DNA from mouse L cells and from studies on its severance by x rays, it seems possible that scission of DNA strand in the cells occurs immediately after irradiation and the number of scissions corresponds to the increase in irradiation dosage. Rejoining of single-stranded DNA following irradiation would be expressed by the following mechanism: severance of DNA strand by irradiation occurs at the 5'-phosphate of deoxyribonucleotide or hexose, and rejoining of the former progresses by ligase immediately after irradiation, while that of the latter is initiated by DNA polymerase after a part of the damaged part is removed by endonuclease, and finally completed by ligase. Thus, the rejoining can be considered as an enzymic reaction, and the enzymes responsible for this reaction are thought to be those present before irradiation, not requiring enzymes to be synthesized after irradiation. In general, rejoining of double-stranded DNA is said not to occur, but such has been seen to occur with bacteria. The difference in rejoining of single-stranded DNA is its rate of rejoining, that of double-stranded DNA being three hours in comparison with about 40 minutes for the rejoining of single stranded DNA. (Japan)

24051 ISOELECTRIC PROPERTIES OF GAMMA-IRRADIATED HORSE-RADISH PEROXIDASE. Delincee, H.; Radola, B. J.; Drawert, F. Int. J. Radiat. Biol.; 19: 93-7(1971).

A monomeric material was isolated from horse-radish peroxidase by column gel filtration. The peroxidase was irradiated at 0°C in a ^{60}Co Gammacell 220 at 1 Mrad/hr, as approximately 1% protein solution. Thin-layer isoelectric focusing in pH3-10 ampholytes showed that the isoelectric pattern of horse-radish peroxidase was qualitatively and quantitatively modified after irradiation in the dose range 0.5 to 2 Mrad. The isoenzymes with the highest pI disappeared with increasing dose and only small amounts of the most acidic isoenzymes remained at 2 Mrads. With increasing dose, the relative amount of the aggregated active enzyme increased, probably due to the formation of an enzymatically active dimer, indicated by the appearance of a component with molecular weight about 100,000. Simultaneously the amount of monomeric enzyme decreased and total enzyme activity decreased with increasing dose. Comparison of the isoenzyme monomers, dimers and aggregates irradiated with 0.5, 1 and 2 Mrads showed that in the isoelectric pattern of the dimers and aggregates the enzyme zones accumulated in the PH 4-6 range with increasing dose. The monomeric enzyme was also modified with increasing dose; the basic isoenzymes disappeared and increasing amounts of the pI 4-6 components were produced. (UK)

24052 RELATION OF X-RAY-INDUCED THYMIDINE UPTAKE TO CHROMOSOME REVERSION AT PROPHASE IN GRASSHOPPER NEUROBLASTS. Thornton, Jacquelyn; Gaulden, Mary Esther (Univ. of Texas, Dallas). Int. J. Radiat. Biol.; 19: 65-78 (1971).

Unscheduled DNA synthesis (thymidine uptake) induced by 32 R of x-rays was followed autoradiographically in individual grasshopper neuroblasts. It occurred in those prophase cells that undergo chromosome reversion (chromosomes "decondense," appearing to move backward in the cell-cycle), but not in those that were delayed in the cycle without chromosome reversion or that progressed with no delay. The latest point in prophase at which unscheduled DNA synthesis was observed was the initial part of late prophase. Hypotonic culture medium, which by itself caused decondensation of prophase chromosomes but not unscheduled DNA synthesis, enhanced both chromosome reversion and unscheduled DNA synthesis when these were induced by radiation. (auth) (UK)

24053 CHROMOSOME ABERRATIONS AND CHANGES IN MITOSIS FOLLOWING COMBINED THERAPY WITH RADIOIODINE AND X-RAY IRRADIATION. Schwanitz, G.; Wolf, F.; Koch, G. (Univ., Erlangen-Nuremberg, Ger.). Folia Clin. Int.; 18: 327-38(Jun 1968). (In Spanish).

Because of thyroid carcinoma, two patients, one male, one female, received combined treatment with ^{131}I and x radiation. In addition, trenimon was administered. By means of leukocyte culture, chromosome analysis was performed according to Moorhead's method. Numerous breaks and dicentric chromosomes occurred during metaphase. Resulting from these disturbances, mitotic changes within the cell cycle were displayed as follows: laggings and bridgings during anaphase and telophase between daughter nuclei; micronuclei and chromatin bridges during interphase. The possibility of genetic damage following radioiodine treatment was pointed out with respect to young patients. (tr-auth)

24054 CORTICOSTEROID CHANGES IN RATS AND MICE DURING THE FIRST HOURS FOLLOWING X-IRRADIATION. Flemming, K.; Geierhaas, B.; Hellwig, J. (Univ., Freiburg i. B. Heiligenberg-Institut, Ger.). Arch. Pharmakol. Exp. Pathol.; 264: 228-9(1969). (In German).

The corticosteroid content of the adrenal gland and blood was determined fluorometrically in irradiated rats and mice. Enhancement of corticosteroid commenced immediately after irradiation and lasted for 2.5 hours. Maximal values occurred at 5 minutes postradiation. Up to 10,000 R, the effect increased with dose and was more pronounced in female than in male rats. It was concluded that the corticosteroid increase following x-irradiation represented a stress reaction. (H.B.G.)

24055 EFFECT OF 2,4,6-TRIETHYLENE-IMINO-S-TRIAZINE AND X-RAYS ON CHICK EMBRYO PHOSPHATASES. Tempel, K.; Jaehde, M. (Univ., Munich). Berlin. Muenchen. Tieraerztl. Wochenschr.; 83: 299-302(Aug 1970). (In German).

Chicken embryos were treated with 2,4,6-triethylene-imino-s-triazine (TEM) (10 or 20 μg/egg) or x-irradiation (340-1.360 R) on the 8th day of development. Wet weight, protein- and phosphatase content decreased during the following three days. 24 hours after injection of TEM, specific activity of both phosphatases was slightly elevated. When embryo homogenate was subjected to differential centrifugation at 5.600–135.000 xg (0.25 M Saccharose, 20 min), 40% of the acid and 20% of the alkaline phosphatase activities remained in the last supernatant fraction. Distribution of phosphatases in the subcellular fractions remained unaltered after treatment of the chicken embryos with TEM or x-rays. Changes observed may be induced by inhibition of nucleic acid- and protein synthesis. (auth)

24056 CHANGE OF THE CHLOROPLAST MEMBRANE SYSTEM UNDER THE INFLUENCE OF ULTRAVIOLET RADIATION. Shakhov, A. A.; Golubkova, B. M. (Inst. of Plant Physiology, Moscow). Dokl. Akad. Nauk SSSR; 194: 214-17 (Sep-Oct 1970). (In Russian).

Data concerning the use of ultraviolet quanta by the membrane system of the cell are of great interest for evolutionary phytophysiology. The presence of photoreceptors of ultraviolet photons in the cells and the membranes determines the activity of photochemical reactions induced by the ultraviolet radiation. In order to study changes in the membrane systems of chloroplasts, experiments were carried out with radish plant in Armenia at an altitude of 3200 m, where the high intensity uv radiation induced photoreactivation; the plants were also irradiated with lamps emitting blue violet, green, and uv radiation. It was found that the supplementary irradiation of the plants causes changes in the chloroplast matrix. The uniform granulation becomes lumpy and then subject to injury. The membrane system was found to be more resistant to ultraviolet radiation than the matrix itself. The conformational changes of the members are probably dependent on the wavelength of the radiation. (TTT)

24057 STUDIES OF THE MODE OF ACTION OF IONIZING RADIATION ON THE INTERRELATION OF COLLAGEN MOLECULES IN FIBRILS. Van Caneghem, P.; Lapiere, Ch. M. (Univ., Liege, Belgium). Int. J. Radiat. Biol.; 18: 401-13(1970). (In French).

Depolymerization of fibrils formed by polymerizing native collagen in vitro was retarded by moderate amounts of x rays (2.5 to 20 krads). The rate of depolymerization in the cold could be modified by several conditions (pH and ionic strength of the solution, the duration of the heat polymerization) which did not affect the radiosensitivity of the collagen irradiated after gelification. This macromolecule was more radiosensitive when irradiated in solution than under its polymeric form. The molecular lesion induced by x rays was irreversible and seemed to result mainly from an indirect effect. (auth) (UK)

24058 COLLAGEN: AN AGING STRUCTURE. CHANGES AFTER IRRADIATION. Svojtkova, E.; Deyl, Z.; Rosmus, J. (Health Inst. of Uranium Industry, Prague). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 219-26(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

Depolymerization of lyophilized collagen occurs only at high doses of radiation. Cross-links accumulating within the structure with age, prevent the irradiated structure from solubilization. The number of breaks within the structure is limited. Four types of macromolecular fragments were observed when rat skin collagen was γ irradiated, namely, a high molecular fragment, scarcely entering the polyacrylamide gel of the molecular weight higher than 3×10^5 and three fragments of molecular weights 2.9, 5.0, and 7.0×10^4. Besides, a small proportion (ten percent) of low molecular dialyzable peptides was recovered, that according to the sequential analysis, belong to the telepeptide region. (auth)

24059 BEHAVIOUR OF CATALASE AND INORGANIC PYROPHOSPHATASE IN MICE BRAIN AND LIVER FOLLOWING UV IRRADIATION. Capalna, S.; Stefan, Maria; Ghizari, Eugenia. Stud. Cercet. Fiziol.; 15: 389-93(1970). (In Rumanian).

The behavior of hepatic catalase and liver and brain inorganic pyrophosphatase was studied in mice exposed to uv radiations at 250 nm during 1, 2, 3, and 6 hrs. Enzyme activity was measured 24 and 48 hrs after irradiation. Catalase activity decreased proportionally with time of exposure to uv and time of investigation after exposure. Brain inorganic pyrophosphatase had an oscillatory behavior, while liver pyrophosphatase after 3 hrs irradiation was activated. The theoretical significance of the experiment seemed to be that uv rays have an inhibitory and stimulating dose-dependent effect on enzyme activity. (auth)

Immunology

Refer also to abstracts 24220, 24310, 24385, 24392–24394, and 24407.

24060 (AEC-tr-7195, pp 292-303) CERTAIN INDICES OF NATURAL IMMUNITY IN MICE UNDER CHRONIC ADMINISTRATION OF ^{90}Sr. Goloshchapov, P. V. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive Isotopes and the body.

The problem of the state of natural immunity under the chronic effects of small doses of ionizing radiation has been inadequately studied. As a result, a study of the normal bacteria of the oral cavity and the skin, bactericidal properties of the skin, and the resistance of mice to salmonella typhi murium following oral administration of ^{90}Sr to female mice and their subsequent offspring was undertaken. It was concluded, on the basis of the data obtained, that chronic intake of ^{90}Sr into the bodies of offspring of mice of 0.00035, 0.0035, 0.035, and 0.35 μC per day led to a reduction of natural immunity that appeared as a reduction in the bactericidal function of the skin, an increase in the autoflora of the skin cover and the oral cavity, the rise of bacteremia, and a rise in the mortality of the animals. Natural immunity decreased with higher ^{90}Sr doses and longer intake periods. (E.E.H.)

24061 (IAEA-R-737) THE STUDY OF THE RADIOSENSITIVITY OF FILARIDS (BRUGIA MALAYI) WITH RESPECT TO ITS USE FOR IMMUNISATION. Final Report, 15 December 1968-15 December 1969. Ramachandran, C. P. (International Atomic Energy Agency, Vienna (Austria)). Feb 1970. 6p. NTIS (U. S. Sales Only).

Attempts are described to immunize domestic cats (Felis domestica) with x-irradiated infective larvae of sub-periodic Brugia malayi, the major (zoonotic) filarial parasite of man in Malaysia. Third-stage infective larvae from experimentally fed Aedes (Finlaya) togoi mosquitoes were irradiated with 10–40 kR giving 6 exposure dose vaccines. Cats between 2 months and 1 year old were inoculated with 200 larvae at 2-week intervals and challenged one month later by inoculation of 100 normal larvae. The majority of the cats on challenge came down with a patent infection at all irradiation doses. Whereas x-irradiation (20,000 R) and subsequent double vaccination had elicited antibody formation which suppressed the development of challenge inoculations to patency in Rhesus monkeys, no such clear results were obtained with cats. It would appear that x-irradiation fails to inhibit the development of the infective larvae but may affect the reproductive capacity of the parasite. (INIS)

24062 GRAFT-VERSUS-HOST REACTIONS IN MICE. I. KINETIC AND IMMUNOGENETIC STUDIES OF ALLOANTIGEN-SENSITIVE UNITS OF LYMPHOID TISSUE. Bennett, Michael (Roswell Park Memorial Inst., Buffalo). Transplantation; 11: 158-69(Feb 1971).

Lymph nodes, spleen, and thymus (but not bone marrow) contain alloantigen-sensitive units (AASU) which proliferate in the spleens and lymph nodes of lethally irradiated, allogeneic recipient mice. Proliferation was assayed by measuring the incorporation of 5-iodo-2′-deoxyuridine-^{125}I ($^{125}IUdR$), a specific deoxyribonucleic acid (DNA) precursor. Exposure of grafted lymphoid cells to H-2 or multiple non-H-2 alloantigens was necessary to induce proliferation. Growth was exponential between 2 and 6 days after grafting, and linear relationships existed between inoculum size and $^{125}IUdR$ uptake. No evidence of nonspecific stimulation of lymphoid cells or of marrow-thymus cell synergism was detected. Alloantigenic stimulation enhanced generation of AASU by their immediate precursors, under conditions of limited pool size. Thymectomy prevented differentiation of AASU from marrow stem cells but did not affect formation of AASU from immediate precursors or terminal differentiation and proliferation of AASU. Mutant alleles at the W locus did not affect the growth of AASU, suggesting that separate genetic controls exist for proliferation of AASU and myelopoietic progenitor cells. However, the same immunogenetic controls affected transplantability of AASU and myelopoietic progenitor cells, since both hybrid histocompatibility (Hh-1) and modifying resistance genes were operating in irradiated recipients of lymph node and bone marrow cell grafts. (auth)

24063 BONE MARROW TRANSPLANTATION IN PATIENTS WITH LEUKEMIA. INCIDENCE AND SEVERITY OF GRAFT-VERSUS-HOST DISEASE IN SUCCESSFUL HL-A-MATCHED TRANSPLANTS. Graw, Robert G. Jr.; Santos, George W. (Na-

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tional Cancer Inst., Bethesda, Md. Johns Hopkins Univ., Baltimore). Transplantation; 11: 197-9(Feb 1971).

Possible mechanisms for increased incidence of graft-versus-host reactions in leukemic patients are discussed. A table is presented of cases of HL-A matched allogeneic bone marrow transplanted to patients with acute leukemia. Severe graft-versus-host reactions and death occurred in three of eleven successful graft cases. One of the patients who died had received total body x radiation for immunosuppression. The significance of bone marrow transplantation in patients with leukemia is discussed. (H.L.W.)

24064 INFLUENCE OF IMMUNOLOGICAL FACTORS ON THE ANTITUMOR ACTION OF 4-DIPHENYLYLGLIOXAL IN EHRLICH ASCITES CANCER. Melan, F.; Testorelli, C. (Univ., Milan). Arch. Ital. Patol. Clin. Tumori; 12: 57-67 (Jan-Jun[1969]). (In Italian).

Immune reactions were increased in animals following administration of a vaccine prepared from x-irradiated cells an Ehrlich ascites carcinoma, and this increased the antitumorigenic activity of 4-biphenylylglyoxal. Immune reactions were inhibited in animals given whole-body irradiation and there was a diminished response to 4-biphenylylglyoxal. When the 4-biphenylylglyoxal and vaccine were administered simultaneously, there was no effect on the immune reactions. (auth)

24065 RADIATION EXPOSURE-RATE DEPENDENCE OF THE IMMUNE RESPONSE IN MICE. Carlson, Donald E.; Gengozian, Nazareth (Oak Ridge Associated Universities, Tenn.). Radiology; 97: 433-8(Nov 1970).

The effects of the acute radiation exposure rate upon the formation of circulating antibodies were studied in mice exposed to 200 to 800 R ^{60}Co γ radiation at 8 to 72 R/min. After 400 to 800 R, antibody formation decreased as the exposure rate increased. Maximum rate dependence occurred when the antigen was given twelve hours before 700 R. Cell transfer studies demonstrated that exposure-rate dependence occurred at the immune-cell level. Comparison between exposure-rate-dependent thirty-day mortality and rate-dependent immune suppression suggested that these two measures of exposure-rate-dependent damage are not parallel. (auth)

24066 EXTRACORPOREAL IRRADIATION OF THE BLOOD. II. IMMUNOSUPPRESSIVE TREATMENT IN KIDNEY TRANSPLANTATION. Weeke, Eva; Andersen, Vagn; Soerensen, Soeren Freieslebes; Bahr, Bjarne. Ugeskr. Laeger; 132: 580-5(19 Mar 1970). (In Danish).

Seventeen patients in terminal uremia were treated with extracorporeal irradiation of the blood (EGI) as pre-transplantation immuno-suppressive therapy. Eleven patients had received a kidney transplant, and eight of these were treated with ECI after the transplantation also. The transit dose employed was 280 to 610 rads, the average total dose 54,600 rads. In all patients, the lymphocyte concentration in the blood decreased during ECI, on the average of 20 percent of pretreatment values, or 290 ± 110/μl. No correlation was observed between transit dose and decrease in lymphocyte concentration. After ECI the lymphocyte counts remained below 50 percent of pretreatment values in all patients including those that were not transplanted and therefore did not receive other immunosuppressive therapy (maximum 14 months of observation). Ten patients received a kidney transplant from a related living donor (2 A 1 match, 6 C match, 2 D match), and one a necrokidney (D or E match). All transplanted patients were treated with azathioprine and prednisone; the dosages employed were relatively small. Two rejection episodes occurred, but slight and reversible, and renal function is now, 1 to 12 months after transplantation, normal in all. Further clinical and experimental studies are necessary in order to clarify the role of ECI as immunosuppressive therapy. (auth)

24067 TRANSPLANTATSIYA KOSTNOGO MOZGA PRI LUCHEVYKH PORAZHENIYAKH. (Bone Marrow Transplantation During Radiation Injuries). Butomo, N. V. Leningrad; Izdatel'stvo Meditsina Leningradskoe Otdelenie (1970). 192p.

Current research on the transplantation of hematopoietic cells into irradiated organisms, their development within the organism, and the possibilities and prospects of practical applications of bone marrow transplants are considered. In the first part, the pathogenic basis for transplanting bone marrow during radiation sickness, the history of the procedure, the methods involved in carrying out myelotransplantations, and the assessment of the results are discussed. Here also is found a detailed description of the peculiarities that characterize the course of radiation sickness and the changes in hematopoiesis following bone marrow transplantation in different animals and in man. In the second part, the mechanisms of action of bone marrow transplants and the development of secondary disease are discussed in relation to ways of overcoming immunological barriers and other complications. The third part contains evidence of possibilities of using cadaveric bone marrow in the treatment of radiation injuries in relation to the preservation of marrow cells. Evidence for the use of bone marrow transplantation in man and the role and place of myelotransplants in the treatment of radiation sickness are also discussed. The bibliography contains 670 citations. (tr-auth)

24068 GRAFT–HOST INTERACTIONS OF LYMPHOID TISSUES. Hilgard, Henry Rohrs. Minneapolis; Univ. of Minnesota (1970). 77p. University Microfilms Order No. 70-27,127. Thesis.

The interactions of graft and host lymphoid tissues were studied in mice injected with suspensions of lymphoid cells. Immunologic activity of the donor cells was detected by weight loss and mortality, and by the graft-versus-host spleen assay. Runt disease can be produced by the injection of lymphoid cells from A strain donors into tolerant chimeric A strain recipients which harbor (A × C57)F_1 hybrid allogeneic cells. Tolerant recipient mice that were not lymphoid chimeras escaped runting when injected with syngeneic lymphoid cells. The rejection of a massive cellular allograft of (A × C57)F_1 spleen cells by a normal A strain mouse produced no evidence of runting. Hybrid hosts given 500 R prior to the injection of parental strain spleen cells showed decreased spleen size relative to controls receiving either irradiation only or irradiation plus hybrid spleen cells. Splenomegaly was therefore not always a reliable indication of the presence of a graft-versus-host reaction. A graft-versus-host splenomegaly response could be elicited from 500 R x-irradiated hosts if the hosts were reconstituted by injection of bone marrow cells from unirradiated donors. Thymus cells and bone marrow cells were both required to produce splenomegaly in 500 R x-irradiated hosts. In this requirement for both thymus and bone marrow cells, the bone marrow cells played a non-immunologic, proliferative role in the splenomegaly. There was therefore no interaction of the two cell types in the production of the specific immune response itself. (Diss. Abstr. Int. B) (TSS)

24069 UNSUCCESSFUL IMMUNOSUPPRESSION WITH RADIOACTIVE GOLD COLLOID IN CANINE LIVER ALLOTRANSPLANTATION. Shiu, Man H.; Evans, Richard; Fortner, Joseph G. (Memorial Hospital for Cancer and Allied Diseases, New York, Sloan-Kettering Inst., New York). J. Nucl. Med.; 12: 138-40 (Mar 1971).

Intravenous administration of ^{198}Au colloid was used to induce immunosuppression in dogs with liver allografts. Despite achievement of lymphopenia and selective continuous irradiation of the liver allograft, unabated graft rejection occurred. Radioactive gold colloid may still be useful as an adjunctive immunosuppressive in liver allografting, but further work is required. (E.E.H.)

24070 EFFECTIVENESS OF CHEMICAL RADIOPROTECTION OF PRIMARY IMMUNE RESPONSE DURING IRRADIATION WITH DIFFERENT GAMMA-RAY DOSES. Sumerska, T.; Denchev, V. (Inst. of Epidemiology and Microbiology, Sofia). Compt. Rend. Acad. Bulg. Sci.; 23: 1175-7(1970).

Studies were done on the primary immune response in chemically protected mice irradiated with different doses of gamma rays. The radioprotective effects of serotonin gradually decrease from 300 to 400 rads, but increase with 500 rads. (P.B.M.)

Ecology

Refer also to abstracts 24009, 24129, 24132, 24134, 24429, 24435, 25948, 26005, and 26009.

24071 (BMI–171-136) AMCHITKA BIOENVIRONMENTAL PROGRAM: SEA OTTER STUDIES DURING "MILROW" FINAL PROGRESS REPORT, JULY 1, 1969–JUNE 30, 1970. Wright, R. A. (Battelle Memorial Inst., Columbus, Ohio). Feb 1971. Contract AT(26-1)-171. 16p. Dep. NTIS.

Milrow, an underground nuclear test of about 1-megaton yield, produced no apparent ill effects on the sea otter populations around Amchitka Island, Alaska. Fifteen experimental animals in beach pens provided with fresh water were undamaged, although only about 4,300 feet from Surface Ground Zero (SGZ). Five otters in a floating pen in the Pacific Ocean about 10,300 feet from SGZ were undamaged. Of five otters in another floating pen 9,200 feet from SGZ, one was found dead, but death could not be attributed to Milrow. An immediate necropsy revealed no test-related symptoms or symptoms characteristic of drowning. The remaining experimental animals appeared healthy and hungry. No test-related symptoms were observed in four of the experimental animals sacrificed three days after the test. That regular beach patrols after Milrow revealed no dead otters leads to the conclu-

sion that the Amchitka sea otter population was not adversely affected. (auth)

24072 (BNWL–1549) A BIBLIOGRAPHY OF ENVIRONMENTAL RESEARCH: ECOSYSTEMS DEPARTMENT, 1952–1970. O'Farrell, Thomas P.; Christensen, Valerie K. (eds.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jan 1971. Contract AT(45-1)-1830. 104p. Dep. NTIS.

Approximately 1,000 references are presented to report and journal literature that documents the results of ecological studies performed in the Richland, Washington area under contract with General Electric Corporation and Battelle Memorial Institute. (C.H.)

24073 (BNWL-SA–3291) RADIATION ECOLOGY IN FRESHWATER COMMUNITIES. Cushing, C. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). 21 May 1970. Contract AT(45-1)-1830. 17p. (CONF-700554–1). Dep. NTIS.

From Conference on man and the aquatic community; Corvallis, Ore. (7 May 1970).

The presence of radioactive isotopes in freshwater ecosystems, regardless of their source, can provide a wealth of ecological data. Information ranging from the movement of a single element from one organism to another, or from one tissue to another, to data helping to unsort the complexities of entire aquatic food chains can be gained with properly designed experiments and treatment of the data. The dynamics of radionuclide cycling are basically no different from their stable counterparts, but their value lies in the increased precision of measurement, particularly at concentrations too low to measure by standard analytical procedures. (auth)

24074 (BRH/DEP–70-26, pp 8-39) ENERGY POLLUTION OF THE ENVIRONMENT. Morgan, Karl Z. (Oak Ridge National Lab., Tenn.).

In Electronic product radiation and the health physicist.

Energy forms that may present hazards to human populations are discussed, including mechanical, chemical, electromagnetic, and elementary particle sources. The fact that energy pollutants in the environment usually interact with each other and sometimes display a synergistic relationship may increase the hazard. It is concluded that these energy forms are essential to the modern way of life and should present no real hazard if kept under proper control. (C.H.)

24075 (ORO–2412-35) EFFECTS OF RADIATION ON PLANT AND ANIMAL COMMUNITIES. Progress Report, January 1970–January 1971. Platt, Robert B. (Emory Univ., Atlanta, Ga.). Contract AT(40-1)-2412. 102p. Dep. NTIS.

The design and performance of a NaI anticoincidence-shielded Ge(Li) γ spectrometer for quantitative measurements of low-activity radioisotopes in environmental samples are discussed. Nineteen radionuclides were measured in samples of caribou liver at concentrations ranging from less than a few dpm/kg of ^{54}Mn to over 5,000 dpm/kg of ^{40}K and ^{137}Cs with ^{60}Co and ^{108m}Ag concentrations of about 5 dpm/kg. Plans are reported for an ecological survey of the proposed site of a nuclear fuel reprocessing plant to be located near Aiken, S. C. Data are included from studies on the ecology of plants and animals in the Panola Mountain and South River areas in Georgia. (C.H.)

24076 (P–4415(RAND)) FIFTY ENVIRONMENTAL PROBLEMS OF TIMELY IMPORTANCE. Libby, L. M. (comp.) (RAND Corp., Santa Monica, Calif.). Sep 1970. 67p.

A list is presented of 50 environmental problems. Included are the possible effects of radioactive waste disposal methods and the location of nuclear power reactors on the environment. (C.H.)

24077 (TID–25650) A SELECTED BIBLIOGRAPHY OF TERRESTRIAL, FRESHWATER AND MARINE RADIATION ECOLOGY. Schultz, Vincent (Washington State Univ., Pullman. Dept. of Zoology); Whicker, F. Ward (Colorado State Univ., Fort Collins. Dept. of Radiology and Radiation Biology). 1971. Contracts AT(45-1)-2221; AT(11-1)-1156. 185p. Dep. NTIS.

A bibliography of approximately 2500 references is presented. Some topics included are status and needs of radiation ecology; environmental radioactivity; radionuclide concentration; ionizing radiation effects; radiation sources; peaceful uses of atomic energy; waste disposal; ecological consequences of a nuclear war; glossaries; sources of information; and additional bibliographies. (H.L.W.)

24078 FETAL AND INFANT MORTALITY AND THE ENVIRONMENT. Tamplin, Arthur R. Bull. At. Sci.; 25: No. 10, 23-9(Dec 1969). (UCRL–71999).

An analysis of data on the causes of infant and fetal mortality in the United States between 1900 and 1970 is presented. The influence of nutrition, prenatal care, and other socio-economic factors; the introduction of antibiotics; and fallout radiation on infant mortality are considered. The impact of changes in recording practices and methods for the collection of statistics on fetal and infant mortality during the period on the interpretation of comparative data is discussed. (C.H.)

24079 MECHANISMS OF ^{90}Sr BEHAVIOR IN FOOD CHAINS FOLLOWING ATMOSPHERIC DEPOSITION. Dibobes, I. K.; Zaidman, S. Ya.; Panteleev, L. I.; Skryabin, A. M. Gig. Sanit.; No. 1, 41-4(Jan 1969). (In Russian).

Investigation of the ^{90}Sr contamination of plants by global fallout led to the discovery that the rate of aerial contamination of plants was 20 to 200 times higher than the rate of plant contamination from soil containing the same density of contaminant. This situation precludes the existence of a linear relation between contamination of plants and the average annual rate of precipitation. A two-compartment split model, considering both aerial and soil sources of ^{90}Sr in the food chain, was suitable for describing plant contamination. Analysis of the data concerning the ^{90}Sr content of separate components of the food chain showed that a linear relation exists between the ^{90}Sr contents of successive components of the food chain. From this, coefficients of proportionality can be determined for use in predicting the ^{90}Sr content of any component of the food chain. (tr-auth)

24080 ACTIVITY AND PENETRATION OF ^{137}Cs IN VARIOUS SOILS. Schauer, Th.; Kreuzer, W.; Schmidt, H. (Univ., Munich). Zentralbl. Veterinaermed., Beih.; No. 11, 149-53(1970). (In German).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

Thirty-one soil samples from Bavaria, selected from 15 different environments: high moorland, low moorland, forest, and sand, were examined gamma-spectrometrically for ^{137}Cs contamination. At 10 of the 15 sites profile measurements were carried out to determine the depth of penetration of the ^{137}Cs. Results showed that the soils with the highest organic content had the highest contamination, particularly high moorland peat soil. Poor sandy soils with low organic content (2–5 %) are least contaminated. A clear correlation exists between ^{137}Cs contamination and humus content. In high moorland soils at 30 to 40 cm depth there was still more than 100 pCi/100 g ^{137}Cs, whereas in sandy soils there were only traces even at 10 cm depth. (auth)

24081 REGULARITIES OF ^{90}Sr AND ^{137}Cs MIGRATION IN DIFFERENT LINKS OF FOOD CHAINS IN ZOOCOENOSIS. Il'enko, A. I. (Inst. of Evolutionary Morphology and Ecology of Animals, Moscow). Zh. Obshch. Biol.; 31: 698-709(Nov-Dec 1970). (In Russian).

Studies were made on ^{90}Sr and ^{137}Cs transport in different links of food chains and their distribution from prey to predators (predatory fishes, reptiles, and mammals). The content of ^{90}Sr increased and that of ^{137}Cs decreased in some tissues of mammals and phytophagous and insectivorous birds as compared with the content in food. During the transport of these tracers from prey to predators (predatory fishes, reptiles, and mammals) the content of ^{90}Sr and ^{137}Cs in the skeleton and muscles of the latter increased. The amount of ^{137}Cs in the muscles of predatory birds was lower than in the body of rodents on which they fed and that of ^{90}Sr in the bone tissue of predators was lower than in prey skeleton. Differences in the content of tracers in various links of food chains in the biocoenosis were due to ecological and morphological differences between the organisms that constituted the food chains. The amount of tracers varied in animals that differed in type of feeding. (auth)

24082 ^{90}Sr LEVEL OF VARIOUS WHEAT VARIETIES IN SLOVAKIA. Csupka, S.; Carach, J.; Petrasova, M. (Regional Hygienic Station, Bratislava). Pol'nohospodarstvo; 15: 964-71 (1969). (In Slovak).

With the decrease of ^{90}Sr content in the radioactive fallout, the content in wheat proportionally decreases: compared with 1963, the ^{90}Sr activity in the 1967 fallout dropped by 96%; in wheat the decrease for the same period amounts to 92%. The average ^{90}Sr activity in wheat was 108.7 pCi/kg in 1963 and only 8.6 pCi/kg in 1967. The most generally cultivated wheat varieties were examined and no significant differences in the 1966 ^{90}Sr content were found even by statistical evaluation of the results. (NSA of Czech.)

Genetics and Cytogenetics

Refer also to abstracts 23946, 24039, 24046, 24052, 24355, 24395, 24408, 24437, 24456, 24461, 24465, and 24494.

24083 (NYO-4080-2) BIOLOGICAL AND CHEMICAL STUDIES ON PHYSICAL MUTAGENS. Progress Report, April 1, 1970–March 31, 1971. Person, Stanley; Snipes, Wallace (Pennsylvania State Univ., University Park. Dept. of Biophysics). Jan 1971. Contract AT(30-1)-4080. 24p. Dep. NTIS.

Studies on mutagen specificity in bacteria included effects of ionizing radiation and tritium decay on coding changes in DNA bases; mutagenic effects of ^{14}C-labeled thymine and methyl thymine; studies on ultraviolet light mutagenesis and its repair; and mutagenic effects of cigarette smoke. Studies on development of an improved bacterial system for studying mutagen specificity involved the isolation of a UAG mutation that is not suppressed by UAA suppressors. Mutagenic effects of cytosine-5-^{3}H on bacteria and Drosophila were investigated and identification of decay products was undertaken. Studies on suppressor conversion included conversion of UAG suppressors to UAA suppressors by a single base change at the anticodon site. Research is reported on characterization of genetic coding changes in Escherichia coli produced by ionizing radiation and by the radioactive decay of incorporated tritium-labeled compounds. (H.L.W.)

24084 (ORO-2976-22) GENETIC AND CYTOGENETIC ANALYSIS OF THE EFFECTS OF RECURRENT IRRADIATION AND CHEMICAL MUTAGENS ON GENERAL AND SPECIFIC COMBINING ABILITY IN PEARL MILLET, PENNISETUM TYPHOIDES. Progress Report, May 1, 1970–April 30, 1971. Burton, Glenn W.; Powell, Jerrel B. (Georgia Univ., Tifton. Georgia Coastal Plain Experiment Station). Contract AT(40-1)-2976. 84p. Dep. NTIS.

The effect of gamma irradiation on the forage yields of three pearl millet genotypes was determined in the summers of 1969 and 1970. Each genotype treatment interaction was repeated three times in a 9×9 lattice square design to give a total of 15 plots for each treatment. Good stands and good growth of each genotype combination were obtained both years. (auth)

24085 (ORO-2976-23) GENETIC AND CYTOGENETIC ANALYSIS OF THE EFFECTS OF RECURRENT IRRADIATION AND CHEMICAL MUTAGENS ON GENERAL AND SPECIFIC COMBINING ABILITY IN PEARL MILLET, PENNISETUM TYPHOIDES. Three-Year Review, May 1, 1968–April 30, 1971. Burton, Glenn W.; Powell, Jerrel B. (Georgia Univ., Tifton. Georgia Coastal Plain Experiment Station). Contract AT(40-1)-2976. 71p. Dep. NTIS.

Research was begun in 1962 to study the effects of three cycles of recurrent seed treatment with various dosages of thermal neutrons and ethyl methane sulfonate (EMS) on general and specific combining ability for forage yield. Pearl millet, Pennisetum typhoides, a diploid ($2N = 14$) annual grass used for forage in the United States, was chosen for this investigation. Forage production data, collected for the past three years, on 486 single crosses are tabulated. (P.B.M.)

24086 EFFECT OF MUTATIONS TO RADIOSENSITIVITY ON THE UV-INDUCED MUTAGENESIS IN SACCHAROMYCES CEREVISIAE. Koval'tsova; S. V.; Zheleznyakova; N. Yu.; Zakharov, I. A. (Ioffe Inst. of Physics and Tech., Leningrad). Genetika; 6: No. 12, 78-85(Dec 1970). (In Russian).

Strains of radiosensitive Saccharomyces cerevisiae were tested for uv-induced mutability. The frequencies of mutations to serine resistance were estimated and taken into account. Two uv-sensitive mutants uvs_1 and uvs_2 exhibited a relatively high susceptibility to the mutagenic effect of the uv light. The mutations xrs_2 and xrs_4 sensitive to both the uv and x rays reduced the capacity of producing uv-induced mutations inherent of these strains. The mutation frequency observed in the uv and x radiosensitive strain xrs_1 did not differ significantly from that in the wild type. The interaction of this mutation with the mutation uvs_2 resulted in the increase of the sensitivity to the mutagenic effect of the uv light. The results obtained support the hypothesis that the greatest proportion of uv-induced mutations originate as the result of errors in the repair of DNA lesions. (auth)

24087 IN VITRO STUDY OF THE ACTION OF γ RAYS, HYDROXYLAMINE, AND URETHANE ON THE CHROMOSOMES OF THE DJUNGARIAN HAMSTER. Sokova, I. O.; Kulagina, O. E.; Pogosyants, E. E. (Inst. of Experimental and Clinical Oncology, Moscow). Genetika; 6: No. 12, 58-62(Dec 1970). (In Russian).

Primary cultures of renal and pulmonary cells of young (10 to 14 days old) hamsters (Phodopus sungorus campbelli Th.) and cultures of embryonic cells were exposed to γ irradiation at 50, 100, and 200R. The yield of aberrant cells in these experiments was 20, 50, and 74% respectively. Single chromatid deletion was a predominant type of aberrations. Most isochromatid deletions (24 out of 36) were followed by sister chromatid union. Two chemical mutagens, hydroxylamine (10 and 25 γ/ml) and urethan (10 mg/ml), did not affect the chromosomes of the Djungarian hamster. (auth)

24088 RADIATION-INDUCED RECESSIVE VISIBLE MUTATIONS OF OOCYTES DURING MEIOSIS IN THE SILKWORM. Murakami, Akio (National Inst. of Genetics, Misima, Japan). Genetics; 67: 109-20(Jan 1971).

The mutational effects of x rays and ^{137}Cs gamma rays on the germ cells of silkworm females during the meiotic divisions were investigated. The specificlocus method was used, estimating the incidence of mutations at two loci influencing egg color. Nonlinear curves of mutation frequency vs. radiation dose were observed for oocytes. No significant difference in mutability was found in oocytes from prophase I to the middle of the second meiotic division but after these periods the frequency of mutations gradually increased with age. Oocytes late in the second meiotic division showed a higher sensitivity to mutation production than did oocytes in any other stage. However, the mutation sensitivity of cells near the first cleavage stage was higher than that of any other cell stage throughout the whole life cycle of this insect. It was observed that the frequency pattern of fractionals and whole-body mutations induced by radiation changed as the maturation divisions of the oocytes progressed. (auth)

24089 STUDY OF THE PRESERVATION OF RADIATION INJURIES OF CHROMOSOMES IN GENERATIONS OF IRRADIATED CELLS OF HUMAN DIPLOID STRAINS. Chervonskaya, N. V. (Moscow Inst. of Viral Preparations). Byull. Eksp. Biol. Med.; 70: No. 12, 89-92(Dec 1970). (In Russian).

Investigations were carried out on cells of human diploid strains that preserved the diploid karyotype and their initial properties for a period of 50 ± 10 passages. In the first passage of the culture after x-irradiation in a dose of 50 R the number of cells with chromosomal aberrations amounted to 8.0 to 8.5% against 3.2 aberrant cells in the controls. During the study of chromosomal aberrations in irradiated cells of the first passage, conducted at different periods after irradiation, differences in the spectrum of aberrations were noted indicating reduplication of acentric fragments of injured chromosomes. In the second passage of the culture after irradiation the number of cells with chromosomal aberrations did not exceed control data. The spectrum of chromosomal aberrations in the irradiated cells also approached that in the control culture. (auth)

24090 DIFFERENCES IN MUTATION RATE AND MUTATION SPECTRUM AFTER ACUTE GAMMA IRRADIATION OF MULBERRY SAPLINGS. Katagiri, Koitsu (Sericultural experiment Station, Tokyo). Nippon Sanshigaku Zasshi; 39: 194-200(Jun 1970). (In Japanese).

Dormant buds of 1-year-old saplings of 5 commercial varieties and 4 improved varieties of mulberry, totaling 1,330 plants, were irradiated by gamma rays from a ^{60}Co source using 7.5 kR at 5 kR/hr. The irradiated saplings were immediately planted in a field and only one lateral bud of each sapling was developed into a shoot by disbudding of the others. In the following 2 years, shoots of the previous years were cut back before sprouting, remaining about 10 cm length from the basal part, in order to force the development of the shoots from the remaining parts. The shoots newly developed in each of 3 years were examined for the occurrence of mutations concerning leaf shape, size, and color. The results can be briefly described as follows: A total of 1,167 plants, from which 11, 50, and 40 mutated shoots were obtained in the 1st, 2nd and 3rd year, respectively, survived for 3 years after irradiation. There were apparent differences among varieties as to mutation rate, as expressed by percentage of plants with mutated shoots per surviving plants. A variety which showed a higher mutation rate was likely to give a wider range of mutation spectrum, compared with a variety which showed a lower mutation rate. (Japan)

24091 MUTATION BREEDING OF VEGETATIVELY PROPAGATED CROPS. Broertjes, C. (EURATOM-ITAL, Wageningen, Netherlands). Genet. Agr.; 23: 139-65(Dec 1969).

From 5th Congress of the European Association for Research on Plant Breeding, Milan, Italy. See CONF-680981.

Vegetatively propagated crops contribute substantially to the world's economy. The main advantage of mutation induction is the ability to change one or a few characters of an outstanding cultivar without altering the remaining genotype and must therefore be considered as the obvious means to perfect the leading products of conventional plant breeding. Furthermore it is the only means to perfect the leading products of conventional plant breeding. Furthermore it is the only means to produce genetic variability in sterile crops and in apomicts. The possibilities of mutation breeding depend on three important factors; the genotype of the plant involved, the availability of a discriminative selection method, and the kind of plant material to be irradiated. Furthermore a number of other factors is discussed, viz. what mutagen is to be used, the dose, the duration of the projects, plant breeders' rights, and the production of tetraploids. A survey is given of crops in which mutation breeding is applied, with practical results, if any. (auth)

24092 MUTATION BREEDING IN TETRAPLOID GLADIOLUS (GLADIOLUS GANDAVENSIS V. H.). Moees, A. (Faculte des Science Agronomiques, Gembloux, Belg.). Genet. Agr.; 23: 176-9(Dec 1969).

From 5th Congress of the European Association for Research on Plant Breeding, Milan, Italy. See CONF-680981.

Results obtained in other research on mutagenic treatments in gladiolus are limited to the study of the first generation after treatment. The experiments considered deal with four-year trials and show that in the tetraploid variety Hawai, color mutations of the flowers are induced at a very high rate by gamma rays but ethyl methane sulphonate fails entirely to induce mutations in this gladiolus variety. (auth)

24093 GLADIOLUS IMPROVEMENT THROUGH RADIATION INDUCED SOMATIC MUTATION. Buiatti, M.; Tesi, R. (Univ., Pisa, Italy). Genet. Agr.; 23: 180-5(Dec 1969).

From 5th Congress of the European Association for Research on Plant Breeding, Milan, Italy. See CONF-680981.

The fate of induced somatic mutations was followed through three vegetative generations in five varieties of Gladiolus, four triploid (Oscar, Mansoer, Johann Strauss, Aristocrate) and one tetraploid (S. Souci). Dormant bulbs were irradiated with 4000 R, 6000 R, and 75000 R of γ rays. Scoring for flower colors was conducted on spikes deriving from irradiated bulbs, secondary bulbs, and bulbis v M(1), v M(2), v M(3), and mutated areas calculated. Thirteen different mutations were found, their frequency being highest in v M(1) lower in v M(2), and increasing again in v M(3). Sectors were found to increase steadily through the three subsequent generations covering the whole plant in about 80% of bulbils. (auth)

24094 MUTATION BREEDING IN SEXUALLY PROPAGATED PLANTS. Scarascia-Mugnozza, G. T. (CNEN, Rome. Univ., Bari, Italy). Genet. Agr.; 23: 187-219(Dec 1969).

From 5th Congress of the European Association for Research on Plant Breeding, Milan, Italy. See CONF-680981.

The urgent need for a world-wide progress of agriculture has brought to an intensification of the work aimed at the improvement of crop species. It seems therefore very wise to make use in plant breeding of experimental mutagenesis. This for two main reasons: mutations of genes and chromosomes, further enhanced by hybridization and recombination, are essential events responsible for the existing differentiation of crop plants; mutagenic treatments can broaden the genetic variability. The utility of mutagenesis applied to plant breeding is indeed an undeniable fact. However, several important questions concerning the effective use of induced mutations have to be more deeply investigated and clarified before we can obtain the maximum benefits for plant breeding purposes. Thereby, this report aims at identifying and focusing — from the view-point of a breeder — those significant problems, the solution of which should be of preeminent importance for a further enhancement of this methodology. (auth)

24095 CONTRIBUTION TO THE PROBLEM OF EVOLUTION OF MAIZE BASED ON VERY UNUSUAL RADIATION MUTANTS. Tavcar, A.; Kendjelic, V. (Univ. of Zagreb). Genet. Agr.; 23: 220-30(Dec 1969).

From 5th Congress of the European Association for Research on Plant Breeding, Milan, Italy. See CONF-680981.

In maize as well as in other Gramineae the leaves and ears on the nodes and the tassel branches are alternately inserted. About 40 yr ago in one homozygous inbred line selected from one of our ecotypes of yellow flint maize, one plant was developed on which the leaves, ears, and tassel branches were inserted in opposite (decussate) position. Eight years ago in one of our homozygous line of which the seed was irradiated with 3000 R one plant with opposite insertion of leaves, ears, and tassel branches was developed in M(3) generation as an induced mutant similar to the earlier observed spontaneous mutant. From the descript spontaneous mutant as well as from the radioinduced mutant in the following inbreds generation beside the normal plants, which were in majority, plants with many abnormalities in the insertion of leaves, ears, and tassel branches were developed. Through continued selfing of these abnormal plants heterozygous genotypes were obtained. (auth)

24096 ANALYSIS OF THE RICE MUTANTS INDUCED BY X RAYS AND RADIOACTIVE PHOSPORUS. Majumder, Balaram (Univ., Milan). Genet. Agr.; 23: 231-4(Dec 1969).

From 5th Congress of the European Association for Research on Plant Breeding, Milan, Italy. See CONF-680981.

For the improvement of rice, mutants were induced in the varieties namely Dular, Marichbati, Jhanjee, Satika, and Chinsura Boro-2 by irradiating them with x rays and radioactive phosphorous. Dry seeds of these varieties were irradiated with different doses of x rays and ^{32}P, in the years 1958 to 1960. In the subsequent generations many selections were made from the irradiated population for changed morphological and quantitative characters. Yield trials were performed and tolerance against high nitrogen doses (non lodging) were tested for mutants and their respective controls, during the past few years. (auth)

24097 EFFECTS OF X RAYS ON LUCERNE. Zannone, L.; Rotili, P. (Istituto Sperimentale per le Colture Foraggere, Lodi, Italy). Genet. Agr.; 23: 236-46(Dec 1969). (In French).

From 5th Congress of the European Association for Research on Plant Breeding, Milan, Italy. See CONF-680981.

S(0) and S(3) seeds of two different plants of the lucerne cultivar Eskisohehir were exposed to x ray treatment, at the dose of 30 kR (220 kV, 12 mA filter of 4 mm of aluminum, 20°C, open air; seed moisture 8.5%. Treatment effects are analyzed in X(1) generation on the basis of germination rate, seedling development and growth. On the adult plants height number of stems, number of nodes on the longest stem, and dry matter weight of the whole plant are analyzed. The study is carried on the next generations, obtained by panmictic fertilization within each of four groups respectively, treated S(0) and control, treated S(3) and control, considering the induced variability on seedling and plant characters, and the longevity of plants derived from treated seeds, compared with the control. In the present report the results on X(1) generation and X(2) seedlings are referred. (auth)

24098 USE OF GAMMA RAYS TO INDUCE GENETIC VARIABILITY FOR QUANTITATIVE TRAITS IN SOME WHEAT VARIETIES (TRITICUM AEST. SSP. VULGARE). Popovic, A. O.; Zecevic, L. M.; Kuburovic, M. Lj. (Inst. for Small Grains, Kragujevac, Yugoslavia. Inst. for Biological Research, Belgrade). Genet. Agr.; 23: 247-61(Dec 1969).

From 5th Congress of the European Association for Research on Plant Breeding, Milan, Italy. See CONF-680981.

Air-dry seeds of Russian variety Bezostaja 1 and Italian variety Fiorello of wheat were irradiated with 5000 to 20000 R of γ rays. The irradiated material was studied by progeny testing and by employing individual selection. In this paper we are presented data of analysis of induced variability in sublines of M(4) generation. Some quantitative characters which are important from the agricultural standpoint are observed: culm length, ear length, stem rust resistance, and gluten quality. (auth)

24099 GROWTH RESPONSES OF DIFFERENT X-RAY RESISTANT VARIETIES OF TRITICUM AESTIVUM BY IONIZING RADIATION DURING SEED-GERMINATION. Reuther, G. (Institut fuer Botanik, Geisenheim, Ger.). Genet. Agr.; 23: 495-8(Dec 1969).

From 5th Congress of the European Association for Research on Plant Breeding, Milan, Italy. See CONF-680981.

Different x ray resistances of higher plants is dependent on the volume of the nucleus, the chromosomes, and the content of DNA. High x ray resistance is caused by a small nucleus, high number of chromosomes and a high concentration of protecting chemical substances. These results were obtained by comparing species of higher plants with different volumes of nuclei and different numbers of chromosomes. Differences in x-ray resistance of wheat varieties with equal volume of nuclei and the same number of chromosomes was reported. In this report the effect of ionizing radiation on growth and dry matter production of the wheat-varieties "Bayro" and "Walthari" will be described. By radiation of dormant seeds the resistance of Bayro is high and of Walthari very low. (auth)

24100 CYTOGENETIC CHANGES AFTER RADIATION EXPOSURE. Bender, Michael A. (Oak Ridge National Lab., Tenn.). pp 139-54 of Late Effects of Radiation. /Fry, R. J. M. (ed.). New York; Van Nostrand Reinhold Co. (1970).

From Conference on Late Effects of Radiation, Chicago, Ill. See CONF-690559.

Chromosome and chromatid x-radioinduced aberrations and their frequencies in mammalian cells are reviewed. Repair mechanisms, aberration rates, and kinetics are discussed in relation to the LET of the radiation. (P.B.M.)

24101 POPULATION GENETICS AFTER RADIATION EXPOSURE IN MAN. Schull, William J. (Univ. of Michigan, Ann Arbor). pp 155-64 of Late Effects of Radiation. /Fry, R. J. M. (ed.). New York; Van Nostrand Reinhold Co. (1970).

From Conference on Late Effects of Radiation, Chicago, Ill. See CONF-690559.

Drosophila melanogaster were exposed to ionizing radiation and used as a tool to predict the probability of a mutation occuring per locus per generation per roentgen, and to measure the fate of induced mutations in natural populations. The results were correlated with the fate of mutations in the human population. (P.B.M.)

24102 BREEDING FOR HIGH PROTEIN CONTENT AND QUALITY OF RICE THROUGH INDUCED MUTATION. Haq, M. S.; Choudhury, N.; Rahman, M. M. (Atomic Energy Centre, Dacca, Pakistan). pp 63-9 of Improving Plant Protein by Nuclear Techniques. Vienna; International Atomic Energy Agency (1970).

From Symposium on Plant Protein Resources: Their Improvement Through the Application of Nuclear Techniques, Vienna, Austria. See STI/PUB-258; CONF-700612.

A breeding program was initiated to improve the quality and quantity of rice protein through γ irradiation. Preliminary studies have shown wide variations in crude protein content as estimated from Kjeldahl analysis in different local varieties of rice and their mutants induced γ irradiation. Some mutants appear promising as regards yield per acre and the protein content. The dye-binding capacity method was applied for rapid screening of selected mutants for protein and basic amino-acid content. Lysine content determined colorimetrically showed a negative correlation with the total protein content of brown rice. (auth)

24103 INCREASING THE PROTEIN CONTENT OF MAIZE BY MEANS OF INDUCED MUTANTS. Balint, A.; Menyhert, Z.; Sutka, J.; Kovacs, Magda; Kurnik, E. (Univ. of Agriculture Sciences, Goedoello, Hungary). pp 77-85 of Improving Plant Protein by Nuclear Techniques. Vienna; International Atomic Energy Agency (1970).

From Symposium on Plant Protein Resources: Their Improvement Through the Application of Nuclear Techniques, Vienna, Austria. See STI/PUB-258; CONF-700612.

Examination of the zein fraction and lysine content of induced maize mutants showed that both increase and decrease of these components were caused by mutation. Opaque genic mutations were induced in the lines C 103 and M 14 and then isolated. Amino acid analysis proved the reality of the mutants, which were phenotypically opaque. Modified amino acid composition, associated with the recessive homozygous state of the O_2 allele occurred. Investigations showed that, by means of induced mutants, the protein content of the different inbred strains can be increased more rapidly than by selection without mutagen treatment. In the mutant lines produced it is possible, in addition to increasing the protein content, to change several properties useful from a commercial viewpoint. (auth)

24104 INDUCED VARIATION OF PROTEIN CONTENT AND COMPOSITION IN HEXAPLOID WHEAT. Dumanovic, J.; Ehrenberg, L.; Denic, M. (Inst. for the Application of Nuclear Energy in Agriculture, Veterinary Medicine, and Forestry, Belgrade). pp 107-20 of Improving Plant Protein by Nuclear Techniques. Vienna; International Atomic Energy Agency (1970).

From Symposium on Plant Protein Resources: Their Improvement Through the Application of Nuclear Techniques, Vienna, Austria. See STI/PUB-258; CONF-700612.

Hexaploid wheat (variety Bezostaja 1) seeds were treated with ethylenimine (EI), ethyl methanesulphonate (EMS), or γ rays. Compared with controls, an increased variation in protein content as determined by dye binding capacity (DBC) was demonstrated in M_2 and M_3. Multiple regression analysis of M_4 data strongly indicated that the observed variations contain a heritable component. At low and high doses of the mutagenic agents studied correlation coefficients are relatively low, whereas at the medium doses high and significant inter year correlations were obtained. Variation in both protein content and overall amino acid composition was observed. Segregation for mutations affecting protein content still occurs in M_4. Although in certain cases the four plants of an M_3 progeny show a consistently higher or lower protein content compared with the control, it seems that propagation must still be done on a plant progeny basis. In respect to protein content, the prognostic value of M_3 is better than that of M_2, and selection should therefore start in M_3 or M_4. DBC protein and 1000 grain weight were very often negatively correlated in mutant lines, whereas no or weak positive correlation was observed in the control lines. Selection for high protein content may lead to simultaneous selection for reduced synthesis of non protein compounds. There are, however, clear breakers of the correlations with respect to the size as well as yield of kernels. From some 500 M_3 mutant progenies, several lines were obtained with more than 17% protein and at least two lines with more than 20% protein (compared with the average control value of 14.4%), without concomitant low 1000 grain weight and kernel yields. (auth)

24105 COMBINATION OF YIELD AND PROTEIN CONTENT IN TETRAPLOID BARLEY. Gaul, H.; Frimmel, G.; Fritz, A.; Ulonska, E. (Gesellschaft fuer Strahlenforschung, Cologne. Bayerische Landessaatzuchtanstalt, Weihenstephan, Ger.). pp 133-47 of Improving Plant Protein by Nuclear Techniques. Vienna; International Atomic Energy Agency (1970).

From Symposium on Plant Protein Resources: Their Improvement Through the Application of Nuclear Techniques, Vienna, Austria. See STI/PUB-258; CONF-700612.

Tetraploid barley has a number of useful features, including extreme straw stiffness and large seeds. Because of partial sterility and other disadvantages, the kernel yield is reduced to about 50% of that of diploid barley. The increase of the protein content of hulled tetraploid barleys is often 30% or more as compared with the corresponding diploids. Naked tetraploid barleys may attain an increase of 20 to 30%, but diploid hull less barleys usually have a protein content 10 to 20% higher than that of the hulled diploids. Consequently, tetraploid naked barleys have the highest protein content. To increase the yielding capacity of autotetraploid barley, a diploidization program was started, the main principles of which are: annually repeated x irradiation treatment of a large number of seeds of autotetraploid varieties; selection of random plants from recurrently treated varieties to intercross them in a multiple crossing system of F_1 plants during subsequent generations following a convergent crossing scheme; and selection for fertility, tillering, and earliness by applying the pedigree breeding method. (P.B.M.)

24106 AMINO-ACID COMPOSITION OF PROTEIN IN RADIATION-INDUCED VARIETIES OF LUPIN FOR FODDER AND IN ECONOMICALLY VALUABLE MUTANTS OF SPRING WHEAT. Golovchenko, V. I. (Inst. of Agriculture, Kiev); Solonenko, L. P.; Chernyi, I. V.; Khvostova, V. V.; Trofimova, O. S. pp 149-62 of Improving Plant Protein by Nuclear Techniques. Vienna; International Atomic Energy Agency (1970). (In Russian).

From Symposium on Plant Protein Resources: Their Improvement Through the Application of Nuclear Techniques, Vienna, Austria. See STI/PUB-258; CONF-700612.

A new γ-radioinduced variety of lupin was obtained as a result of selection among 950 new alkaloid free mutants for the best biochemical mutation variety. A mutant was obtained in which conversion of the amino acid lysine into alkaloids of the lupanine group is blocked, thereby creating a new positive correlation between a high lysine content and an absence or very low concentration of toxic alkaloids of the lupinine, lupanine and sparteine groups. The variety has a number of new characters and properties: it is alkaloid free; it has a high protein content, with a high lysine concentration in the protein; it is resistant to lodging, frost, fusariosis, and virus diseases; it has a specific plant structure and a capacity for natural defoliation. The variety gives a green bulk yield of 500 to 850 centners/hectare, a dry bulk yield of 70 to 150 centners/hectare and a grain of 25 to 60 centners/hectare. The dry mass contains 20 to 24.5% protein and the grain 42 to 45.6%. The grain protein contains 6.8% lysine, 1.6% lythionine, and 1.3% tryptophan. The grain yields 1300 to 2400 centners/hectare of protein and the green mass 1800 to 2700 centners/hectare. Paper chromatography was applied in studying the amino acid composition of protein in the grain of spring wheat mutants obtained by γ irradiation of the seeds at different doses. The mutants differed from the original variety in their morphological characteristics and in having a shorter vegetation period, higher yield and lodging stability and superior baking properties. Investigations showed that in most of the mutants having some valuable characteristic, showed that in most of the mutants having some valuable characteristic, the total amount of protein in the grain was not lower than in the original variety. A higher heritable variability was found in the quantitative ratio of many amino acids in the protein from the mutant grains. The difference between the mutants and the original variety as regards the concentration of individual amino acids ranged from 0.2 to 2.0 g per 100 g of protein. Three of the mutants studied showed 11 to 18% higher protein yield per hectare in the grains and 10 to 25% higher yield of the essential amino acids. (P.B.M.)

24107 MUTATION BREEDING FOR RUST RESISTANCE IN SOYBEANS. Lu, Y. C. (Chung-Hsing Univ., Taichung, Taiwan). pp 185-7 of Improving Plant Protein by Nuclear Techniques. Vienna; International Atomic Energy Agency (1970).

From Symposium on Plant Protein Resources: Their Improvement Through the Application of Nuclear Techniques, Vienna, Austria. See STI/PUB-258; CONF-700612.

Seeds of three soybean varieties and three strains were treated with γ ray doses of 15, 20, 25, and 30 krad, respectively. The treated varieties or strains were divided into two groups, one of which was planted in the spring crop season and the other in the summer crop season. The germination rate was found to be between 20 and 30%. Fertility was high among M_1 plants, except for those treated with 30 krad. For M_2 planting, seeds collected in bulk and seeds collected randomly at the rate of two beans from each branch of the M_1 plant were planted. About 1500 plants, apparently resistant to rust, were selected for lines in the next generation. M_3 seeds of these 1500 resistant plants were har-

vested in bulk and with some remaining M_2 summer crop seeds were sown at the same location. Their resistance to rust was observed and resistant individuals selected again. (auth)

24108 ACCLIMATIZATION AND IMPROVEMENT OF A LINCOLN VARIETY SOYBEAN THROUGH MUTATION BREEDING. Santos, I. S.; Fukusawa, C. A.; Elec, J. V.; De La Rosa, A. M. (Philippine Atomic Energy Commission, Manila). pp 189-96 of Improving Plant Protein by Nuclear Techniques. Vienna; International Atomic Energy Agency (1970).

From Symposium on Plant Protein Resources: Their Improvement Through the Application of Nuclear Techniques, Vienna, Austria. See STI/PUB-258; CONF-700612.

Soybean seeds were exposed to thermal neutron doses ranging from 2.02×10^{11} to 7.51×10^{13} N_{th}/cm^2. The M_1 generation was field planted for individual plant selection for vigour and high yield potential. Improved vigour and yielding ability of some of the selections were visually evident. (P.B.M.)

24109 MONOGENIC ALTERATION OF SEED PROTEIN CONTENT AND PROTEIN PATTERN IN X-RAY-INDUCED PISUM MUTANTS. Gottschalk, W.; Mueller, H. (Univ., Bonn). pp 201-15 of Improving Plant Protein by Nuclear Techniques. Vienna; International Atomic Energy Agency (1970).

From Symposium on Plant Protein Resources: Their Improvement Through the Application of Nuclear Techniques, Vienna, Austria. See STI/PUB-258; CONF-700612.

The seed protein of 22 x-radioinduced mutants of Pisum sativum was analyzed in relation to seed production. The total seed protein content of seven useful mutants increased, resulting in an improvement of general breeding value. In some genotypes, the disadvantage of reduced seed weight is offset by the high protein content. Striking quantitative and qualitative differences in the protein pattern of different mutants result from the action of single mutant genes. Many different recombinations in the F_2 and F_3 generations were obtained by crossing some mutants with each other to study the joint gene action on protein level. Comparison of their seed production, protein content, intermode length, flowering, and ripening time shows that some strains, homozygous for two mutant genes, are superior to the initial line and represent promising new material with regard to breeding value. (auth)

24110 USE OF STIMULATING AND MUTAGENIC DOSES TO INCREASE PROTEIN CONTENT AND IMPROVE PROTEIN QUALITY IN MAIZE AND PEAS. Zokhrabyan, R. P. (Soil Management Research Inst., Echmiadzin, USSR); Sidorova, K. K. pp 217-26 of Improving Plant Protein by Nuclear Techniques. Vienna; International Atomic Energy Agency (1970). (In Russian).

From Symposium on Plant Protein Resources: Their Improvement Through the Application of Nuclear Techniques, Vienna, Austria. See STI/PUB-258; CONF-700612.

Results are given of a study of changes in the quality of hybrid maize grain as a result of irradiation of the parent components. Crossing of the irradiated parent components in the case of the double interline hybrid VIR 25 caused an increase in the protein content to 27.1% compared with the control, and a marked decrease in the nonprotein nitrogen. Irradiation also caused an increase in the albumin, globulin, lysine, valine, leucine, and isoleucine contents of the hybrid. By experimental mutagenesis mutants of peas with a higher content of crude protein in the grain than in the original variety were obtained. Whereas the protein content in the grain of the original variety was 21.83%, that of the K-11 mutant was 25.07% and of the K-17 mutant 24.79%. A group of mutants having 0.8–1.5% higher protein contents that the original variety was selected. All the high protein mutants are distinguished from the original variety by their morphological characteristics. The K-11 mutant has light green spots on its leaves and stipules; the K-17 mutant has wide pods. When the mutants were back crossed to obtain F_2, a monofactorial segregation took place in accordance with the morphological character of the mutant. (auth)

24111 GENETIC ASPECTS OF SELECTION FOR PROTEIN AFTER MUTATION INDUCTION. Micke, A. (International Atomic Energy Agency, Vienna). pp 229-36 of Improving Plant Protein by Nuclear Techniques. Vienna; International Atomic Energy Agency (1970).

From Symposium on Plant Protein Resources: Their Improvement Through the Application of Nuclear Techniques, Vienna, Austria. See STI/PUB-258; CONF-700612.

Prospects of mutation breeding for seed protein improvement depend on various factors. In addition to the requirement for an effective mutagen treatment, there is the need to apply appropriate selection procedures to detect the induced genetical changes. The desired changes will be a rare event, and to raise the probability for selecting usable mutants mutagen doses have to be kept relatively low, so as to minimize multiple mutations. Consequently, large populations must be screened by proper chemical or nuclear mass screening techniques. To diminish the analytical workload as much as possible, screening should be done in the earliest possible generation. However, the generation in which screening is not only feasible but gives reliable information on the variant genotypes depends on several factors: the genetical characteristic of the species, the plant organ for which the protein improvement is intended, and the particular genes concerned. (auth)

24112 MUTABILITY OF VARIOUS BARLEY VARIETIES. Valodzin, U. G.; Kartel, M. A.; Lisouskaya, Z. I.; Krasulevich, L. A. (Inst. of Genetics and Cytology, Minsk). Vestsi Akad. Navuk BSSR, Ser. Biyal. Navuk; No. 6, 39-44(1970). (In Belorussian).

The mutability of 21 varieties of spring barley of Russian and foreign selection was studied. As evidence of mutability in the varieties, chlorophyll and morphological mutations were analyzed. Before sowing, the seeds were γ-irradiated to a dose of 20 kR at a dose rate of 36 R/sec. Multirowed barley of the variety Nalidum showed a higher mutability than the others as demonstrated by chlorophyll mutation evidence. Among the other varieties, the variety Nutans, itself mutable, turned out to be a combination of the varieties Nutans 226 and Gania Loosdorfskaya. The separate varieties exhibited an unequal range of chlorophyll mutations. In general, among all of the varieties tested, the predominant mutations were albino (52.1%) and yellow (26.0%). No connection was observed between chlorophyll and morphological mutations in the M_2 generation of the varieties tested. It was not possible, based on intensive mutation studies in barley, to judge the mutability of a variety on the basis of the frequency of chlorophyll mutations alone. (tr-auth)

24113 MUTAGENIC SENSITIVITY OF DIFFERENT GENOTYPES OF SORGHUM TO TREATMENTS WITH RADIATIONS, CHEMICAL MUTAGENS, AND COMBINATION TREATMENTS. Ramulu, K. (Agricultural Coll. and Research Inst., Coimbatore, India). Madras Agr. J.; 57: 279-88(May 1970).

Mutagenic sensitivity of three cultivars CO 11, CO 12, and CO 18, belonging to Sorghum durra and S. subglabrascens and also the relative effects of radiations, chemical mutagens and combination treatments were studied. Differential responses were observed among the varieties to different mutagenic treatments as evaluated in respect of germination, survival and seedling growth. The LD.50 for the above characters varied among the three varieties in treatments with radiations and chemical mutagens. Among the varieties studied, CO 12 was found to be the most sensitive, while CO 11, the least. The treatments with gamma rays were more effective than the other single treatments with x-rays and chemical mutagens in reducing germination, survival and seedling growth. The mutagens, methyl methane sulphonate and n-nitrosoethyl urea, showed more drastic effects than the rest of the chemical mutagens. The combination treatments exhibited synergistic effects in respect of germination, survival and seedling growth. The mutagenic sensitivity not only depended on the genotype but also on the type of mutagen used. Different phenomena responsible for the genotypic differences are discussed. The effective dose levels in treatments with radiations, chemical mutagens and combination treatments have been indicated to carry out further mutation breeding programmes in Sorghum. (auth) (INIS)

24114 MORPHOLOGICAL ABNORMALITIES DETECTED IN THE M_1 GENERATION OF VICIA ERVILIA AND LATHYRUS SPECIES FOLLOWING GAMMA IRRADIATION OF DRY SEEDS. Shaikh, M. A. Q. (Atomic Energy Centre, Dacca, Pakistan). Nucleus (Karachi); 7: 183-9(Jul 1970).

Air-dried seeds of V. ervilia and seven species of Lathyrus were irradiated with 5, 10, 15, 20, 25, 30, and 50 Krads of ^{60}Co γ rays. The types of abnormalities observed in the M(1) generation were twin seedlings, stubby and severely damaged seedlings, seedlings showing loss of apical dominance, mottled and crinkled leaves, bifurcated leaves, bushy and small leaved plants, deformed and/or unfilled pods, black seed coat, and black and white chimeric seed coat color. None of these variations bred true in the M(2) generation. (auth)

24115 STRANDEDNESS OF CHROMOSOMES: EVIDENCE FROM CHROMOSOMAL ABERRATIONS. Heddle, John A. (Univ. of California, San Francisco). Can. J. Genet. Cytol.; 11: 783-93(Dec 1969). (UCSF-10-P-2-86).

Studies were made on the chromosome aberrations produced by irradiating synchronous cells of the root tips of Vicia faba seedlings to test the hypothesis that chromosomes are multistranded. The data from four experiments demonstrate that chromatid aberrations do occur at the second mitosis after irradiation. An exposure of 100 R produced a high frequency of sidearm bridges at

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the first mitosis and a considerable number of chromatid aberrations in the tetraploid second mitosis. These results infer that chromatids are multistranded. To test this assumption Vicia faba root tips were treated for 12 hrs with 5-aminouracil and then irradiated 10 to 20 min after removal from the chemical. Tetraploid cells were then induced by colchicine treatment. The results showed a similarity in the frequency of chromosome aberrations in the second division cells that were derived by faithful replication from chromatid aberrations. Cells irradiated when no sidearm bridges were produced had a 0.436 frequency per cell compared to 0.444 frequency per cell in other populations. This data indicate that the replication of irradiated chromatids is accurate but not as accurate as normal replication. (E.E.H.)

24116 ELEMENTS OF THE S-GENE COMPLEX. VI. MUTATIONS OF THE SELF-INCOMPATIBILITY GENE, PSEUDO-COMPATIBILITY AND ORIGIN OF NEW SELF-INCOMPATIBILITY ALLELES. **Pandey, Kamla Kant (Department of Scientific and Industrial Research, Palmerston North, New Zealand). Genetica; 41: 477-516(1970).**

Spontaneously occurring mutations of the S gene, involving both the S_1 and the S_{F1} classes of alleles, were studied in Nicotiana alata. The results showed that while almost all of the irradiation-induced mutants of the S gene required S bearing duplication for their survival, usually in the form of a free fragment, most of the spontaneous mutants in the same species, surprisingly, did not have such a requirement. This difference was attributed to the greater depth of mutations produced in response to the ionizing radiations, which necessitated complementation for the survival of the mutants. There is a possibility from the data that the S_{F1} class of alleles may have even less need for the duplication than the S_1 class of alleles. Both pollen and stylar part mutations of the S gene were obtained, but the majority of the mutations were partial, producing less than half the normal complement of seeds per pod in the mutants. Complementation was observed in the style between a ♀-part mutant allele S_{F11}♀ and a normal allele S_{F10}, which was the other allele in the parental plant that produced the mutant. No complementation occurred with another normal unrelated allele S_2. Recent literature on the S gene structure, mutational specificity of S alleles, and genetic control of pseudo compatibility was reviewed. The time of S gene action was discussed in relation to the mechanism of the generation of new self incompatibility alleles. (P.B.M.)

24117 INDUCTION OF GRAIN SIZE AND COLOUR MUTATIONS IN RICE (ORYZA SATIVA L.) BY RADIOISOTOPES. **Basu, A. K.; Basu, Rabindra Krishna (Bose Inst., Calcutta). Theor. Appl. Genet.; 40: 232-6(1970).**

Seven mutants with changes in grain size and in pigmentation of various organs were isolated in the M_2 and M_3 generations of the Patnai variety of winter rice after treatment with ^{32}P and ^{35}S. Some of these could be useful for breeding. The narrow grain mutant, isolated in the M_3 generation after treatment with ^{32}P, was high-yielding and had fine grains and an increased number of long panicles. Two short grain mutants with changed husk color were obtained in the M_2 generation after treatment with ^{32}P. One was also early maturing. One purple apiculus and three purple husk mutants were isolated in the M_2 generation after treatment with ^{35}S. Some of these also had reduced plant height and short grains. The purple apiculus mutant bred true for stigma and apiculus color, but segregated for leaf sheath color. In purple husk mutants the segregation of mutant characteristics was unusual and there was manifestation of new characters. (auth)

24118 CHROMOSOME CONSTITUTION AND ITS BEARING ON THE CHROMOSOMAL RADIOSENSITIVITY IN MAN. **Sasaki, M. S.; Tonomura, A.; Matsubara, S. (Tokyo Medical and Dental Univ.). Mutat. Res.; 10: 617-33(Dec 1970).**

Blood samples obtained from patients with various types of inborn chromosome abnormalities were exposed to γ rays and the relationship between the chromosome constitution and chromosomal radiosensitivity of lymphocytes was studied by analyzing types and frequencies of radioinduced chromosome aberrations. The results showed that the chromosomal radiosensitivity was consistently higher in the cells which were trisomic for the whole or a part of a chromosome than in the cells with normal karyotype, but it was not significantly influenced by the monosomic conditions, reciprocal translocation and inversion. Age of the subjects also affected the chromosomal radiosensitivity, which was elevated in the neonates. The analysis of chromosome aberrations showed that the high frequency of radioinduced chromosome aberrations was due to the increased production of exchange aberrations and that the level of deletions was not affected either by factors of the chromosome constitution or of the age of the subject. A hypothesis to explain the increased chromosomal radiosensitivity of the trisomic cells was given in line with the effects of altered enzyme activity on the production of exchange aberrations. The parallelism between the increased chromosomal radiosensitivity in the trisomic cells and the susceptibility of the affected persons to neoplasia allowed us to recognize that the trisomic cells are particularly cancer prone and that the illegitimate repair of chromosome damage, which is intrinsic to the trisomic cells, may play an important role in the development of cancer. (auth)

24119 CHROMOSOME ABERRATIONS INDUCED BY X-RAY THERAPY AND MYXOVIRUS INFECTION IN HUMAN PERIPHERAL LEUKOCYTES. **Stenman, Svante; Nordling, Stig; Holsti, Lars R.; Saksela, Eero (Univ. of Helsinki. University Central Hospital, Helsinki). Mutat. Res.; 10: 607-16(Dec 1970).**

The dose response relationships and the distribution of breaks induced by irradiation were studied in phytohemagglutinin-stimulated peripheral lymphocytes from female patients treated with x rays for cancer of the breast. The yield of dicentrics and rings was expressed by the formula $y = 0.0086 + 1.53\ (+0.15) \cdot 10^{-5}D$, and the yield of fragments by $y = 0.022 + 1.68\ (\pm 0.17) \cdot 10^{-5}$ D, where D is the accumulated skin dose in rad. The percentage of damaged cells, however, reached a plateau of 22% at about 6000 rad. In all dose ranges, the distribution of cells with various numbers of breaks deviated significantly from a Poisson distribution, which should have been obtained if all cells in the blood were exposed to irradiation. It was possible to calculate the number of undamaged cells present in excess and, when these were omitted, a close agreement with a Poisson distribution was obtained. The results suggested that almost 30% of the circulating lymphocytes were exposed to irradiation with the fractionated partial body procedure utilized. The effect of Newcastle disease, Sendai, measles, and mumps virus infection in vitro on peripheral blood lymphocytes from irradiated patients was also studied. Virus treatment caused a decrease in the frequency of chromosome type damage. No effect, or a slight decrease of chromatid type damage, was seen as compared with controls treated with normal allantoic fluid. (auth)

24120 CYTOLOGICAL ANALYSIS OF PARTIAL AND TOTAL X-CHROMOSOME LOSS INDUCED BY X-RAYS IN OOCYTES OF DROSOPHILA MELANOGASTER. **Traut, H.; Scheid, W. (Univ., Muenster, Ger.). Mutat. Res.; 10: 583-9(Dec 1970).**

With the aid of a cytological technique (analysis of metaphase chromosomes of larval cerebral ganglia) it was shown that, in experiments on X-chromosome loss induced by x rays in oocytes of Drosophila melanogaster, one has to distinguish between partial and total chromosome loss. For this purpose a scheme was devised allowing the detection of aberrant F_1 individuals already at the larval stage. After treatment of mature oocytes, X-chromosomal fragments of various sizes were found. On the other hand, most of the X-chromosomal fragments observed after irradiation of immature oocytes had the same size as chromosome IV points. Possibly this finding is simulated by the combined induction of complete X loss and nondisjunction of chromosomes IV. Otherwise preferential breakage close to the X-chromosomal centromere after irradiation of immature oocytes would have to be assumed to account for the observation of points. About 39% (13/33) of the losses induced in mature oocytes by 400 R were shown to be partial ones. Depending on the classification of the points observed after treatment of immature oocytes with 3500 R, between 7% (3/43) and 23% (10/43) of the losses were partial ones. No indication was obtained either after irradiation of mature or of immature oocytes that the loss frequencies observed for imagoes and larvae differed from each other, e.g. because of selection. The two track component of the dose effect curve of x ray-induced (total plus partial) X-chromosome loss seems to be based completely in the mature, partly in the immature oocyte experiments on the induction of partial losses requiring two independently produced breaks. (auth)

24121 CAUSE OF DIFFERENTIAL RADIOSENSITIVITY OF EARLY CLEAVAGE STAGES IN DROSOPHILA MELANOGASTER. **Matter, Bernhard E. (Eidgenoessische Technische Hochschule, Zurich). Mutat. Res.; 10: 567-82(Dec 1970). (In German).**

During the early cleavage stages of Drosophila melanogaster, radiosensitivity, with respect to dominant lethals, is highest in ana-teleophase and lowest in inter-prophase. The basis of this stage specific difference was analyzed. Different nuclear division stages of D. melanogaster were treated with hydrogen sulphide (H_2S) and or x rays under aerobic and anoxic conditions. As a measure of dominant lethals, the early embryonic mortality (i.e. death during cleavage) was recorded. This lethal syndrome is supposed to result from chromosomal damage. The following results were obtained: H_2S is a radioprotective agent with dose modifying properties, the protection by H_2S is almost equal under aerobic and anoxic conditions, i.e. independent of the amount of oxygen in the cells, and the protection by H_2S varies with the cell cycle, highest in ana-telophase and lowest in inter-prophase. From these results

it was concluded that to a large extent the induction of dominant lethals during cleavage divisions of Drosophila depends on the amount of natural radical scavengers which varies with nuclear division stages. The balance between free SH groups and S-S bridging within the chromosomes is a factor of primary importance connected with stage sensitivity. (auth)

24122 DOSE DEPENDENCE FOR RADIATION-INDUCED ALLELIC RECOMBINATION IN CHLAMYDOMONAS REINHARDI. Lawrence, C. W. (Atomic Energy Research Establishment, Wantage, Eng.). Mutat. Res.; 10: 557-66(Dec 1970).

The frequency of recombination between the acetate 14A and E alleles of the green alga Chlamydomonas reinhardi can be changed by γ radiation only if germinating zygospores are irradiated during one or other of two short meiotic stages. During the first, which is probably located in preleptotene, the frequency of allelic recombination increased linearly with dose and at 20.3 krad, the highest dose used, recombination frequency was increased by a factor of 7 while zygospore survival was reduced to 58%. During the second stage, probably located in late zygotene or early pachytene, a maximum increase of 1.5 to 2 times the control frequency was found at doses between 2 and 5 krad, higher doses producing no further increase. The spontaneous recombination frequencies in zygospores from two different crosses, obtained by mating two different acetate 14A strains to a common acetate 14E stock, differed by a factor of about 10, suggesting that the acetate 14A strains possess different alleles of at least one recombination gene. In absolute terms, the cross which had a high spontaneous frequency exhibited a larger response to radiation, particularly at the second stage, though as a proportion of the control frequency the response was smaller. Zygospores of the second cross were also more sensitive to the lethal effects of the radiation. (auth)

24123 EFFECT OF GAMMA RADIATION AND ALPHA PARTICLES ON GENE RECOMBINATION IN CHLAMYDOMONAS REINHARDI. Lawrence, C. W.; Holt, P. D. (Atomic Energy Research Establishment, Wantage, Eng. Atomic Energy Research Establishment, Harwell, Eng.). Mutat. Res.; 10: 545-55 (Dec 1970).

Low doses of ^{60}Co γ radiation, which kill no more than about 5% of the zygospores, change gene recombination at only 2 short stages during the course of meiosis in Chlamydomonas reinhardi, but higher doses, which kill more than 10% of the spores, depress recombination at all stages up to pachytene. Irradiation with α particles having a mean linear energy transfer (LET) of about 1300 and 1600 MeV g^{-1} cm^2 changes recombination in a manner which appears to combine the effects characteristic of both low and high doses of γ radiation simultaneously. The γ high dose type of response has a relative biological effectiveness (RBE) of between 20 and 35, and the γ low dose RBE is greater than 1 although precise evaluation is impossible due to the complexity of the response. The RBE for survival was 16.5 at the low dose levels studied. (auth)

24124 CHROMATID BREAKAGE: CYTOSINE ARABINOSIDE-INDUCED LESIONS INHIBITED BY ULTRAVIOLET IRRADIATION. Benedict, Willilm F. (New York State Dept. of Health, Albany); Karon, Myron. Science; 171: 680-2(19 Feb 1971).

Exposure to uv light can reduce the frequency of chromatid breaks induced by cytosine arabinoside in the DNA synthetic and post DNA synthetic phases of the cell cycle. This effect can be correlated temporally with a decrease in the uptake of tritiated thymidine after uv treatment, implying that the genesis of such breakage is intimately related to DNA synthesis and that such synthesis is not confined to the DNA synthetic phase. (auth)

24125 CHROMOSOME ABERRATIONS IN BONE MARROW CELLS OF MICE AFTER SINGLE AND FRACTIONATED X-RAY EXPOSURE. Tuscany, R., Globocnik, E.; Sedlak, A. (Inst. of Radiation Hygiene, Prague). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 247-53(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

Mice were x irradiated with a single dose of 400 R or by 10 R and 50 R fractions up to 400 or 800 R total exposure. The rate of chromosome aberrations in the bone marrow cells was investigated and the time course of the decrease of cells carrying unstable aberrations was analyzed. It was found that with dose fractionation there was only one aberration per cell but with single exposures there were almost two aberrations per cell and chromosome exchanges were frequent. (F.M.M.)

Health Physics and Safety

Refer also to abstracts 23912, 23938, 24493, and 24620.

24126 X-RAY HAZARDS IN PRACTICES. O'Riordan, Michael C. (Radiological Protection Service, Belmont, Eng.). Vet. Rec.; 87: 640-3(21 Nov 1970).

A review of radiological safety in veterinary practices is presented to mark the publication of the Code of Practice for the Protection of Persons Exposed to Ionizing Radiations from Veterinary Uses. Physical and medical data point to the disturbing conclusion that a significant number of veterinary personnel have incurred manifest radiation injuries. Concerted action by the profession to reduce the hazards is advocated. (auth)

Radioactive Contamination and Decontamination

Refer also to abstracts 23972, 23974, 23997, 24408, and 24426.

24127 (CEA-N-1408(1)) RADIOACTIVE CONTAMINATION IN WORKSHOPS AND LABORATORIES. TECHNIQUES FOR DETECTION AND MEASUREMENTS. Werderer, Bernard (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Feb 1971. 51p. (In French). Dep. NTIS (U. S. Sales Only).

Techniques associated with the monitoring of water and of air are reviewed, together with techniques for the measurement of surface contamination, under the following headings: units for estimation of contamination by fluids (concentration, accumulated activity); factors affecting the sampling of a fluid (homogeneous and heterogeneous dispersion, dispersion in space, effect of speed of sampling, sedimentation in sampling devices, adsorption on sampling devices); principles of measurement of fluids (direct measurement of sample, collecting activity present in a fluid, collecting atmospheric contamination, collection of aerosols, collecting activity present in water); interpretation of results (inhaled activity, long-lived sources of radiation); principal types of apparatus for measuring accumulated activity (discontinuous monitoring, continuous monitoring); apparatus for measurement of concentration (discontinuous monitoring equipment, continuous monitoring equipment without collection, principal types of contamination detector without collection, equipment combining continuous monitoring with collection); contamination of surfaces (generalized homogeneous contamination, localized contamination, principal detectors used); detection of non-static activity (procedures for suspension, procedures using transfer). 41 references. (France)

24128 (EUR-4546) LEVELS OF RADIOACTIVE CONTAMINATION OF THE ENVIRONMENT AND THE FOOD CHAIN. Annual Report, 1969. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 21 Aug 1970. 62p. (In French). Dep. NTIS (U. S. Sales Only). EUR FF 9,45.

During 1969 the EURATOM-CEA Association continued work on its program directed principally towards research on the data necessary for evaluating the levels of radioactive contamination of the food chain and the environment. In the field of human biology original results were obtained on the metabolism of iodine and thyroid pick-up of ^{131}I in the adult and the child. As regards contamination transfer factors, research was begun on atmospheric contamination via dry media, and considerable progress was made in the study of the transfer of atmospheric contamination via wet media. The study of water-borne pollution has led to interesting contributions, mainly the cycling of ^{58}Co and ^{106}Ru in aquatic ecosystems. The contamination of the food chain by ^{90}Sr and ^{137}Cs via the soil has been studied by vertical analyses, which are now nearing completion. Synthetic studies have led to a new approach to the problems of evaluating the levels of contamination in the case of a pollution of the aquatic medium. (auth)

24129 (MIT-952-7, pp 162-82) ^{137}Cs MEASUREMENTS IN NORMAL MAN. (Massachusetts Inst. of Tech., Cambridge. Dept. of Physics).

In Radium and mesothorium poisoning and dosimetry and instrumentation techniques in applied radioactivity.

Data are presented on the content of ^{137}Cs of five normal humans as a function of time as determined by monthly whole-body γ measurements made from 1961 to 1969. Whole-body γ counting of ^{40}K was also done on group of young men to determine the effects of regular exercise on dietary protein requirements. Computer programs, FORTRAN IV MNSTR(MAIN), were written for use in calculations of ^{137}Cs/^{40}K parameters for man. (C.H.)

24130 (NIRS-RSD-26) RADIOACTIVITY SURVEY DATA IN JAPAN. Number 26, February 1970. (National Institute of Radiological Sciences, Chiba (Japan)). 23p. Dep. NTIS (U. S. Sales Only).

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Results are reported from fallout monitoring studies in Japan during February 1970. Data are presented on the content of ^{137}Cs and ^{90}Sr in dry fallout, rain water, milk, and the total diet; the content of ^{90}Sr in samples of human bones; and the content of ^{137}Cs in man as measured with whole-body counting. (C.H.)

24131 (NP-18749) ESTIMATION OF MEAN RADIATION DOSE TO THE POPULATION OF THE USSR FROM GLOBAL ^{137}Cs. Ushakova, A. P.; Likhtarev, I. A.; Moiseev, A. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1969. 20p. (In Russian). Dep. NTIS (U. S. Sales Only).

The radiation dose to human populations in the USSR from global fallout ^{137}Cs was calculated for the period 1957 through 1969. The highest dose occurred during 1964 and by 1969 the dose was practically zero. (C.H.)

24132 (NRL-F-41) ENVIRONMENTAL RADIOACTIVITY IN NEW ZEALAND. Quarterly Report, July–September 1970 and Pacific Area Monitoring 9 October–31 October. (National Radiation Lab., Christchurch (New Zealand)). 22p. Dep. NTIS (U. S. Sales Only).

Results of routine monitoring of fallout during the third quarter, 1970, are presented and the results of extended monitoring of fallout from the French nuclear tests are continued for samples measured up to the end of October. Eight nuclear devices were tested between May and August in the atmosphere during the year's test series in the Tuamotu Archipelago. Tables are presented to show total beta activity in rain and air samples; ^{89}Sr and ^{90}Sr in rain; and ^{137}Cs, ^{131}I, and ^{90}Sr in milk; and ^{131}I in cattle thyroids. Levels of radionuclides and levels of total beta activity are discussed with regard to potential health hazards. (H.L.W.)

24133 (SWRHL-98-r) OFF-SITE SURVEILLANCE ACTIVITIES OF THE SOUTHWESTERN RADIOI OGICAL HEALTH LABORATORY FROM JULY–DECEMBER 1969. (Public Health Service, Las Vegas, Nev. Southwestern Radiological Health Lab.). Feb 1971. 67p. Dep. NTIS.

During the period July through December 1969, fifteen announced underground nuclear tests were conducted by the U. S. Atomic Energy Commission at the Nevada Test Site, and two events, Project Rulison and Project Milrow, were conducted in Colorado and Alaska. One event, Pod, conducted on October 29, 1969, was detected by GM survey instruments only at Lathrop Wells, Nevada. The peak reading was 0.04 mR/hr net gamma. One power run of the XE-Prime nuclear rocket engine did release radioactivity to the off-site areas. The maximum gross gamma exposure rate measured by portable survey instruments was 0.04 mR/hr. The maximum integrated concentration of ^{131}I on an air sample was 0.45 $\mu Ci\text{-sec}/m^3$. No milk or domestic water sampled showed fresh fission products. All off-site exposures were well below the safety criteria established by the Atomic Energy Commission. (auth)

24134 (TID-25680) STUDIES ON THE NUTRITION AND METABOLISM OF REINDEER-CARIBOU IN ALASKA WITH SPECIAL INTEREST IN NUTRITIONAL AND ENVIRONMENTAL ADAPTATION. Technical Progress Report, June 15, 1970–June 14, 1971. Luick, J. R. (Alaska Univ., College. Inst. of Arctic Biology). Contract AT(04-3)-310. 100p. Dep. NTIS.

Studies on the nutritional physiology of reindeer and caribou, with emphasis on their adaptation to diet and climatic stresses, are reported. Data are presented from studies on seasonal changes in the transfer of ^{134}Cs from reindeer cow to calf; ^{134}Cs uptake and retention in three arctic carnivores, the silver fox (Vulpes fulva), the arctic fox (Alopex lagopus), and the coyote (Canis latrans), measured by whole-body γ counting following the intravenous injection of ^{134}Cs; the content of ^{137}Cs in muscle tissues of wild caribou and wolves and the content of ^{131}I in the thyroid glands of caribou sampled during 1970; and the retention of ^{134}Cs in hibernating arctic ground squirrels (Citrellus undulatus) given ^{134}Cs in drinking water over a two-month period immediately preceding the hibernation period. (C.H.)

24135 INITIAL AND RESIDUAL IONIZING RADIATIONS FROM NUCLEAR WEAPONS. Cook, C. Sharp (Naval Radiological Defense Lab., San Francisco). pp 361-99 of Radiation Dosimetry. Vol. III. /Attix, Frank H. (ed.). New York; Academic Press Inc. (1969).

The basic physical processes and phenomena that occur during the detonation of nuclear weapons are reviewed. It is pointed out that the ionizing radiations resulting from the detonation of nuclear weapons are of many types, depending on the design of the weapon, the geophysical conditions at the time of detonation, and the height of the detonation. The radiation dose resulting from the detonation of nuclear weapons has been arbitrarily classified as initial (radiations emitted prior to one minute following the detonation) and residual, resulting from radiation emitted later than one minute. Most of the residual radiation dose results from fallout debris. A summary is presented of the characteristics, distribution, and some effects of ionizing radiations resulting from nuclear weapon detonations. Methods used for calculations of the resulting radiation doses are discussed. (100 references) (C.H.)

24136 DEPOSITION OF ^{131}I ON PLANT LEAVES. I. Ohmomo, Yoichiro; Saiki, Masamichi (National Inst. of Radiological Sciences, Tokai, Japan). Radioisotopes (Tokyo); 20: 15-19(Jan 1971).

The deposition and the distribution of organic and inorganic ^{131}I on spinach, Chinese cabbage, Komatsuna, and camellia leaves was determined using quantitative analysis and autoradiography. The deposition of $CH_3{}^{131}I$ on Chinese cabbage, spinach, Komatsuna, and camellia leaves was similar. The average concentration of $^{131}I_2$ was greater on spinach and Chinese cabbage than for camellia leaves. It was suggested that $^{131}I_2$ concentrated on leafy vegetables to a greater extent than did $CH_3{}^{131}I$. Removal of ^{131}I from the contaminated leaves was attempted by washing them with detergent, CCl_4, ether, 0.5N HCl, and 0.5N NaOH with very little success. (E.E.H.)

24137 DECONTAMINATION OF ^{137}Cs INCORPORATED INTO MEAT. Kreuzer, W.; Kotter, L.; Maurus, P.; Schroeder, K. (Univ., Munich). Zentralbl. Veterinaermed., Beih.; No. 11, 131-4(1970). (In German).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

Results show that meat contaminated with ^{137}Cs can be decontaminated without seriously affecting its feeding value by various methods of preparation. Pickling in brine of increased concentration (repeated change of brine) and wide brine-meat ratios (10-1) can remove almost all ^{137}Cs from pieces of meat taken from steers and pigs. By cooking in sufficient volume of 2% salt solution and changing the fluid twice, it is possible to decontaminate to an average extent of 78–80% and to a maximum of 87%. Steaming and roasting under prescribed conditions produces decontaminations of 55 to 62% and 39 to 52% of ^{137}Cs, respectively. (auth)

24138 STUDIES ON THE VARYING ^{137}Cs CONTAMINATION OF WILD GAME. Maurus, P.; Schauer, Th.; Kreuzer, W.; Schmidt, H.; Kotter, L. (Univ., Munich). Zentralbl. Veterinaermed., Beih.; No. 11, 135-41(1970). (In German).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

In the interests of rationally organized monitoring, it would be advisable to determine not only the average but also the maximal ^{137}Cs contamination of meat from the total slaughter population coming from a given area. Preliminary studies in an area in the Bavarian Alps showed that meadows on uncultivated pasture and/or on an acid pasture, or the feeding of acid hay produced higher mean or wild game contamination than was observed with intensive grazing. Earlier results of systematic studies in a mountain hunting area showed in autumn a mean contamination of ruminants in the following ascending order: cattle, deer/chamois, red deer. The relatively high contamination of the red deer may be related to the extensive grazing in moist woodland areas and, in an individual case, to grazing in predominantly cereal areas. After transfer to winter feed the contamination of the wild game fell to the level of that in cattle. The study of plant ecology in relation to different species of wild fauna and the ^{137}Cs contamination level of the plants was started. (auth)

24139 CONCENTRATION OF ^{90}Sr IN THE BONES OF HARES AS AN INDICATOR OF CONTAMINATION OF THE BIOSPHERE. Giacintov, Pavel; Zima, Stanislav (Staatliche Veterinaeranstalt, Brno. Landwirtschaftliche Hochschule, Brno). Zentralbl. Veterinaermed., Beih.; No. 11, 142-8(1970). (In German).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

As part of an investigation on the levels of contamination of the biosphere by radioactive substances in Czechoslovakia, the content of ^{90}Sr in bones of hares was examined. Most of the hares studied came from South Moravia. The ^{90}Sr contents of bones of different age groups and of hares from areas with different fallout levels are compared; then a comparison is given for the ^{90}Sr content of bones of children. (auth)

24140 MEAT INSPECTION AND HYGIENIC EVALUATION OF THE MEAT WITH RESPECT TO RADIOACTIVE CONTAMINATION. Kotter, L.; Kreuzer, W.; Schulze, H. (Univ., Munich). Zentralbl. Veterinaermed., Beih.; No. 11, 154-62(1970). (In German).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

In the German meat and food regulations there are no special directions concerning the judgment, utilization, or refusal of animals or their meat after radioactive contamination with ^{137}Cs, ^{131}I, and ^{90}Sr. Meat inspection measures are only taken if the animals or their meat show changes due to irradiation which fall within the general pathological changes covered by the regulations. Since the protection of the consumer from injury by foods of animal origin falls within the duty of the veterinarian, he must deal with radioactive-contaminated meat that cannot be refused under existing regulations by holding it back for further examination. The significance of this form of examination is discussed, as is the occurrence of artificial radionuclides in the animal body and the methods of detecting them. (auth)

24141 EXPERIMENTAL CONTAMINATION OF ANGUILLA ANGUILLA (L.) BY ^{137}Cs AND DECONTAMINATION. Reynier, B.; Foulquier, L.; Grauby, A. (CEA, Cadarache, France). Ann. Limnol.; 6: No. 1, 101-29(1970). (In French).

The kinetics and localization of ^{137}Cs in freshwater and brackish water aquaria containing Camargue eels (Anguilla anguilla) were studied. In freshwater, at the end of the experiment (100 days), more than 90% of the radioactivity was localized in the sediment, where the ^{137}Cs was fixed by adsorption. The fish amassed only a small part of the radioactivity, 0.6 to 1%. The ^{137}Cs extracted from the water at the gill or oral tissue level settled in the muscle where it was retained for a long time. In brackish water, the distribution of the ^{137}Cs in the three parts of the aquarium was: sediment 53%, water 45%, fish 3%. The migration of ^{137}Cs was less rapid because of the inhibitory action of the monovalent ions. However, the ^{137}Cs distribution in the muscles and in the viscera was the same as in freshwater. (auth) (France)

24142 RADIOACTIVITY OF DRUGS, INFUSIONS, AND DECOCTIONS. Genkov, D.; Atmadzhov, P. (Medical Inst., Plovdiv, Bulgaria). Folia Med. (Plovdiv); 11: 322-6(1969).

The results from measurements of beta radioactivity obtained from 57 kinds of herbs growing in Bulgaria are given. The values obtained from the measurement of beta radioactivity of infusion and decoction of the same herbs are also given. (auth)

24143 PLUTONIUM SKIN CONTAMINATION AND DECONTAMINATION BY DECONTAMINANTS. Tashiro, Shingo (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi; 13: 2-7(Jan 1971). (In Japanese).

Eleven decontaminants in an aqueous solution were used to determine the most effective method for plutonium decontamination of skin. Fresh pigskin (used as a substitute for human skin) was contaminated with plutonium chloride in 1-HCl. After washing with water the contamination that remained consisted of that adsorbed by the skin. This was removed by detergents or chelate formation. Synthetic detergents were effective when treatment immediately followed contamination while sodium hypochlorite or EDTA were the most effective after 10 min delay. (E.E.H.)

24144 STUDY OF FALLOUT ^{137}Cs IN THE PACIFIC NORTHWEST. Eberhardt, L. L.; Rickard, W. H.; Cushing, C. E.; Watson, D. G.; Hanson, W. C. (Battelle Memorial Inst., Richland, Wash.). Contract AT(45-1)-1830. J. Wildlife Manage.; 33: 103-12(Jan 1969).

The seasonal and spatial distribution of fallout cesium-137 was measured in a number of ungulates and selected forage plants with emphasis on Douglas fir, bluebunch wheat grass, antelope, elk, domestic sheep, and mule deer. Study sites ranged from southwestern Wyoming to the Washington coast, including two different seasonal precipitation regimes with annual totals from about 7 in. to over 100 in. Radionuclide accumulation in fallout collectors followed the seasonal patterns of precipitation, as did concentrations on vegetation and in animals. Many factors influence the specific expression of these general patterns, and it is suggested that the overall variability and complexity are such that a useful investigation of any contaminant in a natural system requires a sizable minimum expenditure of effort. (EEH)

24145 RELATIONSHIP BETWEEN THE CONCENTRATION OF ^{90}Sr AND ^{137}Cs IN MILK AND THE RADIOACTIVE FALLOUT, TAKEN INTO ACCOUNT WHEN ESTIMATING THEIR FUTURE LEVELS. Csupka, S. (Inst. of Hygiene and Epidemiology, Bratislava). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 15-24(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

Radiostrontium and radiocesium enter milk from radioactive fallout by way of fodder and from milk they enter into the human organism. The relation between the annual deposit, cumulative deposit, and milk contamination of ^{90}Sr and ^{137}Cs is expressed by equations using existing measurements. Two models are set up for calculating future annual and cumulative deposit of ^{90}Sr and ^{137}Cs in milk using the values for the year 1969. One model uses a constant annual deposit and the other a decreasing annual deposit. From these models the concentration of the radioisotopes in milk was calculated for the year 2000. (F.M.M.)

24146 ERYTHROCYTES OF URANIUM MINERS. II. MEASURING OF ELECTROKINETIC POTENTIAL. Roth, K.; Vacek, K.; Adamek, M. (Health Inst. of Uranium Industry, Pribram, Czech. Charles Univ., Prague). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 203-8(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

A simple method for electrophoretic velocity (electrokinetic potential) measurements of erythrocytes was developed. The incubation of erythrocytes in buffered glucose solution produced an increase in electrokinetic potential of blood cells that could be explained by the charge density increase in the interior of the cell during incubation without any considerable change in charge double layer width at the surface of the erythrocyte. (auth)

Dosimetry and Monitoring

Refer also to abstracts 23770, 23791, 23792, 23816, 23817, 23856, 23873, 23903, 23904, 23957, 24269, 24282, 24299, 24330, 24360, 24427, 24505, 24928, and 25584.

24147 (AD-711038) DOSIMETRY FOR STUDY OF HEMATOLOGIC EFFECTS ON PRIMATES OF PULSED VERSUS CONTINUOUS RADIATION. Final Report, November 1, 1967-April 1, 1969. Hardy, Kenneth A.; Jorgensen, Richard E.; Boles, Larry A.; Parker, C. Varren; Blake, Kenneth R. (Texas Nuclear Corp., Austin). Jun 1970. Contract F41609-68-C-0001. 17p. (SAM-TR-70-31). NTIS.

Exposure configurations were developed in support of a study to determine the hematologic effects of pulsed versus continuous radiation on Macaca mulatta primates. The ultimate objective of the study was to determine the possible hematologic effects of whole-body exposure to continuous proton fields by comparison of pulsed exposures to x-rays and protons and continuous (22-hour) exposures to ^{60}Co gamma rays. The criteria to be met in the selection of exposures were: to deliver the required doses over the appropriate time spans, and to deposit the radiation energy in a comparable manner throughout the animal in order to eliminate geometric and depth-dose factors. Descriptions are given of physical techniques used to deliver and measure the necessary spatial and depth-dose distributions and the required radiation doses. Comparative data are presented for each configuration. The depth-dose and spatial-radiation distributions are shown to be comparable for all three configurations. Monitoring with ionization devices and thermoluminescent dosimeters indicated that all of the animals used in the study received radiation exposures to within plus or minus 10% of the programmed values. (auth) (USGRDR)

24148 (AEC-tr-7195, pp 5-11) EVALUATING THE EXISTING MAXIMUM PERMISSIBLE CONCENTRATION OF ^{90}Sr IN THE DIET OF THE POPULATION. Dibobes, I. K.; Sarapul'tsev, I. A.; Skryabin, A. M. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

When the maximum permissible load of ^{90}Sr in the human body has been established, the problem of setting norms for its intake into the human body is reduced to determining the numerical correlation between the maximum permissible load and the maximum permissible concentration for intake. The current maximum permissible concentration in the diet for population as a whole which is equal to 270 ^{90}Sr units does not produce irradiation of the organism above the maximum permissible level /g of tissue in all age groups, including children of an early age. This concentration in the diet of the population must be expressed in ^{90}Sr units and not in absolute concentration in order to prevent over-irradiation of children. The maximum permissible norm for ^{90}Sr expressed in the form of gross content in the skeleton is not suitable for younger age groups. Therefore, for the irradiation category population as a whole, it would be more correct to express maximum permissible norms for ^{90}Sr in grams of calcium (in strontium units) or in grams of bone. (E.E.H.)

24149 (CEA-CONF-1697) AUTOMATIC ANALYSIS OF SPACE AND TRABECULAE SIZES IN THE SPONGY BONE OF BABIES AND CHILDREN. Witmer, G. (Centre National de la Recherche Scientifique, Paris (France)); Perier, J. C.; Lafuma, J.;

Parmentier, N. C. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1967. 10p. (In French). (CONF-670461-3). Dep. NTIS (U. S. Sales Only).

From 7th meeting of radiologist doctors of latin origin and 1st congress of the european association of radiology; Barcelona, Spain (2 Apr 1967).

To study the radiation hazards of diagnostic radiography in babies and children, an estimate was made of the quantity of x radiation absorbed by the bone marrow. The method is based on the use of multiple measurements of the trabeculae and marrow space lengths taken at random on sample sections. These were examined microradiographically over their entire surface by successive scannings. A completely automatic device was developed, presenting the data obtained from bone sections in the form of histograms which can be fed directly to a computer. Samples were taken from children between 0 and 3 years old following death from acute aliments. The ratio between the areas occupied by the bone trabeculae and the marrow spaces, the distribution of space and trabeculae frequency as a function of their dimensions, and the value of the mean trabeculae and space size were determined. (France)

24150 (COO-119-242, pp 268-72) IMPROVED METHODOLOGIES FOR DETERMINING LOCAL BONE DOSIMETRY. Jee, Webster S. S. (Utah Univ., Salt Lake City. Radiobiology Div.).

From Research in Radiobiology.

Improved methodologies for determining local bone dosimetry using the Becker–Johnson neutron-induced autoradiography and spark counting, the Johnson–Becker contact cellulose nitrate autoradiography and spark counting and the Jee–Miller detailed neutron-induced autoradiography are described. Lumbar vertebral bone section from a dog injected with 0.305 μCi of plutonium-239/kg and surviving for 40 days was 3.2 pCi/cm^2 and a section from a dog injected with 0.0148 μCi of plutonium-239/kg and surviving for 35 days was 0.22 pCi/cm^2. (auth)

24151 (DPST-71-30-1) EFFECT OF THE SAVANNAH RIVER PLANT ON ENVIRONMENTAL RADIOACTIVITY. Semiannual Report, July–December 1970. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Mar 1971. 18p. Dep. NTIS.

Results of the environmental monitoring program at Savannah River Laboratory, Aiken, S. C., for the period July 1 through December 31, 1970, are presented. Data are included on levels of radioactivity in the atmosphere, vegetation, milk, food, and water. The quantity of radioactive waste released by the Savannah River Plant to its environs was, for the most part, too small to be distinguished from natural background radiation or was obscured by fallout from offsite sources. (C.H.)

24152 (EUR-4594) AUTORADIOGRAPHY AS A HELP FOR ANALYSING THE DISTRIBUTION OF α-ACTIVE ISOTOPES IN THE HUMAN BODY AFTER AN AIR CONTAMINATION. Vaane, J. P.; de Ras, E. M. M.; von Brandenstein, Chr. (European Atomic Energy Community, Karlsruhe (West Germany). Inst. of Transuranium Elements). 21 Jul 1970. 36p. Dep. NTIS (U. S. Sales Only). EUR F. Fr. 6.65.

According to the lung model of the I.C.R.P. the size distribution of the particles of an aerosol is an important parameter for calculating the distribution of radioactive dust in the respiratory tract. This report gives a review and a short description of autoradiographic methods used to determine the distribution of α-active ^{239}Pu particles collected by dust filters, and an example of such a calculation after the release of α-activity into the respiratory air. (auth)

24153 (JPRS-52402, pp 34-41) MEDICAL SUPPORT AND PRINCIPAL RESULTS OF EXAMINATION OF THE "SOYUZ-9" SPACESHIP CREW. Vorob'ev, E. I.; Egorov, A. D.; Kakurin, L. I.; Nefedov, Yu. G. Translated from Kosm. Biol. Med.; 4: No. 6, 26-31(1970).

The medical support procedures and results of physical examinations given to A. G. Nikolayev and V. I. Sevast'yanov during and after their flight aboard the Soyuz-9 spacecraft are described. Radiation conditions were evaluated on the basis of an admissible dose of 15 rem during the flight, a justified risk dose of 50 rem, and a critical dose of 125 rem. The total radiation dose for A. G. Nikolayev was 0.316 rad and 0.397 rad for V. I. Sevast'yanov. (E.E.H.)

24154 (ORNL-TM-3304) CALCULATION OF THE ABSORBED DOSE AND DOSE EQUIVALENT INDUCED BY MEDIUM-ENERGY NEUTRONS AND PROTONS AND COMPARISON WITH EXPERIMENTS. Armstrong, T. W.; Bishop, B. L. (Oak Ridge National Lab., Tenn.). 5 Feb 1971. 27p. (CONF-710304-1). Dep. NTIS.

From Symposium on Natural and Manmade Radiation in Space, Las Vegas, Nev.

Monte Carlo calculations were carried out to determine the absorbed dose and dose equivalent for 592-MeV protons incident on a cylindrical phantom and for neutrons from 580-MeV proton-Be collisions incident on a semi-infinite phantom. For both configurations, the calculated depth dependence of the absorbed dose was in good agreement with experimental data. (auth)

24155 (ORNL-TM-3320) PRIMARY- AND SECONDARY-PARTICLE CONTRIBUTIONS TO THE DEPTH-DOSE DISTRIBUTION IN A PHANTOM SHIELDED FROM SOLAR-FLARE AND VAN ALLEN PROTONS. Santoro, R. T.; Claiborne, H. C.; Alsmiller, R. G. Jr. (Oak Ridge National Lab., Tenn.). 18 Feb 1971. 33p. (CONF-710304-3). Dep. NTIS.

From Symposium on Natural and Manmade Radiation in Space, Las Vegas, Nev.

Calculations were made using the nucleon-meson transport code NMTC to estimate the absorbed dose and dose equivalent distributions in astronauts inside space vehicles bombarded by solar-flare and Van Allen protons. A spherical shell shield of specific radius and thickness with a 30-cm-diam tissue ball at the geometric center was used to simulate the spacecraft-astronaut configuration. The absorbed dose and the dose equivalent from primary protons, secondary protons, heavy nuclei, charged pions, muons, photons, positrons and electrons are given as a function of depth in the tissue phantom. Results are given for solar-flare protons with a characteristic rigidity of 100 MV and for Van Allen protons in a 240-nautical-mile circular orbit at 30° inclination angle incident on both 20-g/cm^2-thick aluminum and polyethylene spherical shell shields. (auth)

24156 (ORNL-TM-3338) QUARTERLY PROGRESS REPORT ON RADIOLOGICAL SAFETY OF PEACEFUL USES OF NUCLEAR EXPLOSIVES: HYPOTHETICAL POPULATION EXPOSURES IN METROPOLITAN AREAS. Barton, C. J.; Jacobs, D. G.; Kelly, M. J. (Oak Ridge National Lab., Tenn.). 8 Mar 1971. Contract W-7405-eng-26. 22p. Dep. NTIS.

Natural gas from the Gasbuggy well could hypothetically have been either in Los Angeles or in San Francisco if it had been put into El Paso Natural Gas Company's distribution system instead of being flared. Population weighted average dose equivalents to the whole-body, calculated with the assumption that the gas contains 1.0 pCi/cm^3 of tritium at the point of use, are 0.024 millirem/year for inhabitants of the Los Angeles Basin and 0.007 millirem/year for people in the San Francisco Bay area. The radiation doses for maximum exposure conditions in the atmosphere were estimated to be 0.19 and 0.024 millirem/year, respectively. These doses compare with 2.0 and 2.5 millirems/year for exposure to combustion products of the same gas if it were used in homes located in these two metropolitan areas for nonvented heating and in nonvented appliances. Calculations for use of gas having the same tritium concentration to fuel a 1000 MW(e) electric generating plant located in Los Angeles show that, under the worst meteorological conditions, the maximum hypothetical whole-body or gonadal dose that could be received by a small fraction of the people in this area would be 1.3 millirems/year. The maximum calculated doses are only about 1% of the Federal Radiation Council's Radiation Protection Guide of 170 millirems/year. (auth)

24157 ELEMENTARY PHENOMENA IN AN IRRADIATED SYSTEM, APPLICATION TO DOSIMETRY. Abillon, E.; Delattre, P.; Naudet, G.; Senaux, R. (CEA, Saclay, France). Radioprotection; 5: 93-114(1970). (In French).

The effect of radiations on an irradiated system is studied at the elementary interaction level. It is shown that in order to describe the evolution of the system it is necessary to know the interaction cross sections and the spectra of the free particles present in the medium. The parameters used in dosimetry, such as dose, R.B.E., L.E.T., are explained within the mathematical framework presented. (auth) (France)

24158 COMPUTER PROGRAMS FOR IRRADIATION PLANNING IN HIGH-ENERGY THERAPY. Dobry, H.; Benedetti, G. R. (Simens A.G., Erlangen, Ger.). Electromedica; 38: 291-4 (1970). (In German).

Computer programs are presented for use in calculations of the radiation dose distributions in homogenous media of the density 1 g/cm^3, that take into consideration the changes of energy doses and dose distributions due to inhomogeneities in tissues, e.g., lungs or bones. These inhomogeneities are described using the superposition of up to 3 ellipses. By the application of wedge filters the dose distribution can be adapted to the configuration of the focus to be irradiated. The extension of the formerly described programs by consideration of inhomogeneities and wedge filters is described. (INIS)

24159 RADIATION DOSIMETRY. VOLUME III. SOURCES, FIELDS, MEASUREMENTS, AND APPLICATIONS. Second

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Edition. Attix, Frank H.; Tochilin, Eugene (eds.). New York; Academic Press Inc. (1969). 958p. $37.00.

A separate abstract was prepared for each of the 17 chapters. (R.W.R.)

For abstracts of individual chapters see: 23799, 23867–23869, 24135, 24160–24168, 24280, 24281, and 25616.

24160 X RAYS AND TELEISOTOPE γ RAYS. Johns, H. E. (Univ. of Toronto). pp 1-50 of Radiation Dosimetry. Vol. III. /Attix, Frank H. (ed.). New York; Academic Press Inc. (1969).

The production and use of x rays are described. Various electronic means for producing x rays and the properties of the radiation (interactions with matter, spectral distributions, angular distributions) at 30 to 300 kV are discussed. The fabrication and use of radioisotope units employing gamma emitters are explained. The concepts of surface backscatter and depth dose and their variation with photon energy are considered. Finally, methods of determining the spectral distributions of the primary and scattered radiation are presented. Tables of the spectral distributions of x-ray fluence and exposure at a depth of 10 cm in a water phantom for various energies are given. (66 references) (R.W.R.)

24161 DISTRIBUTED RADIONUCLIDE SOURCES. Loevinger, R. (International Atomic Energy Agency, Vienna). pp 51-90 of Radiation Dosimetry. Vol. III. /Attix, Frank H. (ed.). New York; Academic Press Inc. (1969).

After a survey of previous work in the field, there is a brief discussion of the general considerations that enter into distributed radionuclide dosimetry, including the kind of information needed and where it is obtained and the role of a model in formulating the problem. The formalism for dose calculation is then presented in full. The sources of information on nuclear radiations are discussed, as well as the energy distributions of photons and beta particles. (38 references) (R.W.R.)

24162 NATURAL AND MAN-MADE BACKGROUND RADIATION. Mayneord, W. V.; Hill, C. R. pp 401-51 of Radiation Dosimetry. Vol. III. /Attix, Frank H. (ed.). New York; Academic Press Inc. (1969).

Natural background radiation is both extraterrestrial and terrestrial in origin. Sources of the former are cosmic rays, charged particles in the Van Allen belts, and solar protons; while the latter occurs in rocks, soils, and air. Because of this omnipresence some radioactivity finds its way into the body via food, water, or air. The importance of proper interpretation of numerical values of background radiation is stressed; for instance, normal concentration of ^{210}Po is 0.2 pCi per 100 g of wet tissue, but this means one atom present in about 1½ million cells. The chance of a Po atom's being in a given cell is thus very small, but this minute distribution can be estimated to give a mean dose equivalent of 2 mrem/yr. The measurement of external background radiation dose rate is complicated by the presence of extraterrestrial fast neutrons. Methods for determining both the neutron and low-LET components of this radiation are reviewed. High-sensitivity sample-counting methods utilizing alpha, beta, and gamma radiation are discussed; and criteria for choosing among them are given. (164 references) (R.W.R.)

24163 DOSIMETRY OF RADIATION IN SPACE FLIGHT. Sondhaus, C. A. (Univ. of California, Irvine); Evans, R. D. pp 453-521 of Radiation Dosimetry. Vol. III. /Attix, Frank H. (ed.). New York; Academic Press Inc. (1969).

The main sources of space radiation are briefly summarized, and the kinds of radiation likely to be encountered and their modes of interaction with matter are described. Estimates of the biological consequences of exposure to the space radiation environment are discussed, as well as the resulting requirements that these factors place on space radiation dosimetry. Some relevant earth-bound experiments and calculations are described, as well as the results of manned and unmanned space flights. (258 references) (R.W.R.)

24164 RADIATION PROTECTION DOSIMETRY. Kiefer, H. (Gesellschaft fuer Kernforschung, Karlsruhe, Ger.); Maushart, R.; Mejdahl, V. pp 557-616 of Radiation Dosimetry. Vol. III. /Attix, Frank H. (ed.). New York; Academic Press Inc. (1969).

After a brief introduction, the development and present values of radiation protection standards are presented. The dosimetry of external radiation is described in some detail. Area dosimetry, personnel dosimetry, and the special requirements of dosimetry for radiation accidents are explained; the techniques and dosimeters required for handling each type of radiation are considered. Discussions of the dosimetry of internal radiation and dosimetry for the protection of the population conclude the article. (225 references) (R.W.R.)

24165 RADIOBIOLOGICAL DOSIMETRY. Sinclair, W. K. (Argonne National Lab., Ill.). pp 617-76 of Radiation Dosimetry. Vol. III. /Attix, Frank H. (ed.). New York; Academic Press Inc. (1969).

There is often a choice of exposure procedures open to persons performing radiobiological experiments and the appropriate choice can often greatly simplify the work required to specify the absorbed dose at all points of interest. It is pointed out that when standard data are available a single measurement of the absorbed radiation dose can be used to derive the dose absorbed in other regions of interest. Basic radiation parameters that influence radiobiological response are reviewed and the types of experiments in which dosimetry is of paramount importance are discussed. Methods used for direct and indirect measurements of the absorbed radiation dose in biological materials exposed to γ, x, fast neutrons, and charged particles are described. (100 references) (C.H.)

24166 USE OF X AND γ RAYS IN RADIOTHERAPY. Johns, H. E. (Univ. of Toronto). pp 677-741 of Radiation Dosimetry. Vol. III. /Attix, Frank H. (ed.). New York; Academic Press Inc. (1969).

Methods for estimating the radiation dose delivered to the tumor during fixed field or rotation therapy using γ or x radiation are described. Methods for calculations of the integral dose from isodose curves or from energy fluence data and the ratio of the integral dose to the tumor dose are also described. (55 references) (C.H.)

24167 DOSIMETRY IN IMPLANT THERAPY. Shalek, Robert J.; Stovall, Marilyn (Univ. of Texas, Houston). pp 743-807 of Radiation Dosimetry. Vol. III. /Attix, Frank H. (ed.). New York; Academic Press Inc. (1969).

Methods for calculation of the radiation dose distribution in neoplasms and the surrounding tissues when γ sources are used for external contact or intracavitary or interstitial implant therapy are described. The physical properties of the radioisotopes most commonly used as γ sources for therapy are reviewed. These include ^{226}Ra, ^{222}Rn, ^{198}Au, ^{137}Cs, ^{192}Ir, ^{182}Ta, ^{60}Co, and ^{125}I. (130 references) (C.H.)

24168 TRANSITION-ZONE DOSIMETRY. Spiers, F. W. (Univ. of Leeds, Eng.). pp 809-67 of Radiation Dosimetry. Vol. III. /Attix, Frank H. (ed.). New York; Academic Press Inc. (1969).

Theoretical and experimental investigations that bear on the problem of transition-zone dosimetry (i.e., dosimetry near an interface between two dissimilar materials) are considered. A brief review of the relevant anatomical characteristics of the sites where interface effects are likely to be important is first given; this primarily concerns bone, but the skin and lungs are also considered. Energy absorption and secondary-electron release in tissues are treated. The transition-zone dose is next calculated for various geometries, with the variation of energy loss along the particle track taken into account. Methods for calculating the dose in trabecular bone are explained. Comparison of these calculations with experimental investigations of dose in transition zones (although usually with models that simulate the situation in bone) indicates their general validity. Several particular applications of transition-zone dosimetry are treated in the last section. (48 references) (R.W.R.)

24169 SPATIAL DISTRIBUTION OF THE DOSE AROUND THE OGIER–SCARPA UTEROVAGINAL APPLICATOR OBTAINED BY ELECTRONIC CALCULATION METHODS. CLINICAL CONSIDERATIONS. Renzi, R.; Ogier, E.; Marini, G. (Univ., Florence). Riv. Ostet. Ginecol.; 23: 352-67(May 1968). (In Italian).

Dose distribution around the Ogier–Scarpa utero-vaginal applicator was studied with the aid of electronic computers. The method of calculation is described, and the distribution of the dose obtained with reference to a target volume and other healthy structures that surround it, with particular regard to the bladder and rectum is discussed. Under normal conditions of utilization of the applicator on these particularly sensitive structures the dose-limit is not surpassed. This fact was confirmed by data obtained from about 200 applications of full therapy. (auth)

24170 TECHNIQUE OF OBTAINING ISODOSE CURVE FROM FILM DOSIMETRY. Mitsuta, Hideo (Osaka City Univ.); Ito, Keizo; Ono, Masao; Suyama, Tatsuo. Rinsho Hoshasen; 15: 706-11(Sep 1970). (In Japanese).

With an exposed film for obtaining isodose curve, the print on sensitive paper is obtained with a quick copy printer for different exposing time. The part having the density less than a certain density of the exposed film is shown black on this negative print. If a proper printing time is selected, the part corresponding to arbitrarily selected dose can be made the boundary of the blackening part on the negative print. Further, when

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a contact print is made from the negative print thus obtained, the part having more dose than the selected one and the part having less dose than it are expressed as black and white areas respectively with a clear boundary. Then, the isodose curve is obtained by tracing this borderline on tracing paper. This technique can analyze even extremely complex dose distribution without utilizing a high-priced analyzing apparatus. Furthermore, this is superior to the technique utilizing Sabattier's effect in that it does not require a dark room. The disadvantages of this technique are that it has somewhat gross error, and that it takes considerable time for processing. (Japan)

24171 IN VIVO RADIATION DOSIMETRY. REVIEW OF A 12-YEAR EXPERIENCE. Roswit, Bernard; Malsky, Stanley J.; Reid, Cyprian B.; Amato, Charles G.; Goebels, Robert (Veterans Administration Hospital, Bronx, N. Y.). Radiology; 97: 413-24(Nov 1970).

The design and development of systems for direct in vivo measurement of dose within the living subject are described. This method has been used since 1957 for therapy, diagnosis, nuclear medicine, and radiobiology. The systems include home-grown and commercial luminescent solid state dosimeters of various types and geometries, read-out instrumentation, and a methodology for implantation and removal of dosimeters in virtually every body organ and tissue in living patients and animals. (auth)

24172 COMPUTER DOSIMETRY OF PARTIALLY BLOCKED FIELDS IN COBALT TELETHERAPY. Khan, Faiz M. (Univ. of Minnesota, Minneapolis). Radiology; 97: 405-11 (Nov 1970).

The concept of negative image field was introduced to calculate dose distribution in a partially blocked field. In this method, dose at any point at depth is equal to dose from overall field minus dose expected if entire field were blocked, leaving only shielded volume open. This concept was incorporated in the computer program to give dose distribution in a print-out form, using position of the characters as grid points. Two examples, split-field and field with 2 shielding blocks (mantle field) were analyzed. The computed dose distributions were compared with directly measured distributions obtained by isodose curve plotter. (auth)

24173 REGIONAL AND INDIVIDUAL DOSE MEASUREMENTS IN MAN AND ANIMALS. Wachsmann, F. (Institut fuer Strahlenschutz, Neuherberg, Ger.). Zentralbl. Veterinaermed., Beih.; No. 11, 31-5(1970). (In German).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

Measurements of environmental dose and personal dose are important in order to decide the action to be taken by civil defense personnel. In veterinary medicine there is the additional fact that knowledge of the individual dose is important for the decision on emergency slaughter or to determine whether an animal exposed to irradiation can safely be used for further breeding. The features of ionization chamber dosimeters and film and glass dosimeters are discussed in relation to measuring the individual dose. Essentially they are suited to the measurement of β and γ rays, while measurement of thermal and fast neutrons is at present more difficult. (auth)

24174 DOSIMETRY IN BONE WITH PARTICULAR REFERENCE TO TRABECULAR BONE. Spiers, F. W.; Zanelli, G. D.; Darley, P. J. (Univ. of Leeds, Eng.). pp 48-53 of Symposium Ossium. /Jelliffe, A. M. (ed.). London; E. and S. Livingstone (1970).

From Symposium ossium; London (4 Apr 1968).

Investigations relating to measurements of radiation dose absorbed by cortical bone are considered. Dosimetry and radioactive particle path length measurements in trabecular bone are discussed. Calculations of mean marrow dose for single and multiple bone cavities are given. In vitro measurements of mean marrow dose in bone irradiated by x rays and by internally deposited ^{90}Sr β are reported. (UK)

24175 EXPERIMENTAL DEMONSTRATION OF THE INFLUENCE OF BONE ON DOSE DISTRIBUTION IN RADIOTHERAPY. Debois, J. M. (Univ. Hospital St. Raphael, Leuren, Belgium). pp 54-6 of Symposium Ossium. /Jelliffe, A. M. (ed.). London; E. and S. Livingstone (1970).

From Symposium ossium; London (4 Apr 1968).

The effect of the interposition of fresh human bones on the isodose charts was investigated. The influence of the bony pelvis, with the hip joint, the lumbar and vertebral spine and the lower jaw was examined. The costal grid and the skull were also studied and showed no effect on the isodose curves. The curves obtained using telecobalt and telecesium γ beams for lumbar and cervical vertebrae are shown. The amount of bone interposed greatly influenced the distortion of the isodose lines. (UK)

24176 CALCULATION OF THE ABSORBED DOSE IN SOFT TISSUE INCLUSION IN BONE BY CAVITY IONISATION THEORY. Burlin, T. E.; Chan, F. K. (The Polytechnic, London). pp 57-61 of Symposium Ossium. /Jelliffe, A. M. (ed.). London; E. and S. Livingstone (1970).

From Symposium ossium; London (4 Apr 1968).

The similarities of cavity theory and bone dosimetry are discussed. Irradiation was by either x or γ rays. Graphs of soft tissue dose in bone vs photon energy, energy absorbed vs photon energy, inclusion dose/soft tissue dose vs mean pore size, and bone inclusion dose/soft tissue dose vs mean pore size are given and compared with those obtained by other workers. (UK)

24177 PROBLEMS OF ESTIMATING ABSORBED BONE MARROW DOSES TO INFANTS AND CHILDREN FROM RADIOLOGICAL DIAGNOSTIC EXAMINATION. Chemtob, M. (Commissariat a l'Energie Atomique, Fontenay Aux Roses, France); Witmer, G.; Parmentier, N. C.; LaFuma, J.; Lefebvre, J. pp 66-71 of Symposium Ossium. /Jelliffe, A. M. (ed.). London; E. and S. Livingstone (1970). (In French).

From Symposium ossium; London (4 Apr 1968).

Estimations were made of energy absorbed in vertebral marrow of infants and children exposed during intestinal or urinary diagnostic radiography. Calculation of absorbed dose was compared with phantom measurements. Subsequent work will deal with the quantity of bone marrow exposed and the possible effects on the blood-forming system. The mean marrow dose is not much above the muscle dose, but the dose at certain points may be considerably higher. (UK)

24178 RADIATION LOADING OF MEDICAL STAFF IN BULGARIA FOR THE PERIOD 1967–1968 AND SOME ASPECTS OF THE FILM DOSIMETRIC CONTROL. Vasilev, G. Rentgenol. Radiol.; 9: No. 2, 92-6(1970). (In Bulgarian).

Since 1965 Bulgaria has officially applied the Rational Security Standards, common to all member countries of the Mutual Economical Assistance Council and based on standards of the International Committee on Radiation Protection. Mass individual dosimetry is promoted by the Central Laboratory at the Research Institute of Radiology and Radiation Hygiene. A total of 2500 persons are under control (90 percent of them health workers) using the system of film dosimetric control. The results are checked every month and reported if the doses exceed by 5 percent the maximum admissible ones. In 1967 and 1968 more than 90 percent of the controlled medical workers received less than $^1/_{10}$ of the maximum admissible doses. Only 0.6 percent (in 1967) and 1.6 percent (in 1968) received doses exceeding the maximum admissible dose for a year (5 roentgens). (Abstr. Bulg. Sci. Med. Lit.)

24179 DEPTH DOSE AND QUALITY FACTOR FOR NEUTRONS IN RADIATION PROTECTION. Wagner, S. (Physikalisch-Technische Bundesanstalt, Brunswick). Atomkernenergie; 16: 243-6(1970). (In German).

The depth dose calculations for monoenergetic neutrons start from different assumptions on the phantom and on the irradiation conditions. The resulting maximum equivalent doses and effective quality factors are collated and discussed. There are considerable differences in both quantities. For radiation protection purposes an upper limit of the maximum equivalent dose is obtained by using the results of the calculations for the slab phantom with normally incident neutrons. Measuring devices, the indication of which is proportional to the maximum equivalent dose as obtained in these calculations should not be required to provide a smaller uncertainty than about ±50%. (auth)

24180 CALCULATION OF INTEGRAL DOSES IN RADIO-COBALT THERAPY. Dubinin, I.; Chvojka, Z. Sb. Ved. Pr. Lek. Fak. Karlovy Univ. Hradci Kralove; 12: 293-301(Nov 1969). (In German).

A mathematical model was developed in order to calculate total integral doses, integral doses received by a tumor, and the ratio of both (i.e., the integral dose coefficient), which is needed when planning the treatment procedure in ^{60}Co teletherapy. The technique of calculating these parameters was demonstrated on a practical example. (NSA of Czech.)

24181 STATISTICAL REPRESENTATIVITY AND BIOLOGICAL MEANING OF RADIOACTIVE AIR CONTAMINATION SAMPLING IN WORKING AREAS. Frittelli, L.; Moccaldi, A.; Tagliata, S. (CNEN, Rome). Minerva Fisiconucl.; 12: 285-95 (Oct-Dec(1968). (In Italian). (RT/PROT-(69)33).

Radioactive air contamination in working areas may be detected by means of samples analysis. Results of these analyses are con-

sidered in pointing out the inhalation risk to workers. The relation between a fixed high flow sampling device, which gives general information in the areas in a given period of time, and a portable one of variable flow, which can be placed near the worker, is discussed with respect to the inhalation activity. Results of others using different samplers under various conditions were considered. Results obtained from the different devices during a U–Th mixed oxalate centrifugation are discussed. (auth)

24182 REPORT ON THE CONCENTRATION LIMIT FOR RADIOACTIVE MATERIALS IN THE FOOD OF CHILDREN AND ADULTS. Breuer, F. (CNEN, Rome). Minerva Fisiconucl.; 12: 233-8(Oct-Dec 1968). (In Italian). (RT/PROT–(69)40).

The concentration limits of radioelements for members of the public are generally directly correlated with the maximum permissible concentrations for occupational exposure. These concentration limits are intended for adults, but in several cases they are not sufficiently conservative for children. It is therefore useful to have some correction factors available, corresponding to the ratio between the dose received by an adult and that received by a child exposed to the same concentrations of radioelements in air or in food. A general formula is given for calculating the correction factors to be applied to the maximum permissible concentrations of radioelements in food for continuous exposure. The results for some radioelements are reported. (auth)

24183 DETERMINATION OF DOSE DISTRIBUTION IN ^{60}Co IRRADIATED DOGS BY LiF DOSIMETERS. Neruda, O.; Zachvej, J.; Hedvicakova, L. (Purkyne Medical Research Inst., Hradec Kralove, Czech. Inst. of Nuclear Research, Prague). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 159-61(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

Lithium fluoride dosimeters were placed in various tissues, organs, and on the body surface of dogs that had been bled to death. Cobalt-60 irradiation was carried out and the values for dose distribution are tabulated. (F.M.M.)

24184 PRACTICAL ASPECTS OF BETATRON ELECTRON BEAM DOSIMETRY. Jacobson, Ahren; Birkhead, B.; Scott, R. M. (Univ. of Louisville, Ky.). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 111: 607-12(Mar 1971).

Some of the problems of electron beam calibration and dosimetry for therapy are presented along with practical methods of handling them. Without such methods, accurate dosimetry would be most difficult to obtain. Film dosimetry has been especially useful in giving a reproducible method of rapidly determining accurate dose distributions. (auth)

Radiation Protection

Refer also to abstract 23558.

24185 (AERE-Trans–1134) RADIATION SAFETY STANDARDS, 1969. Translated by J. E. Baker (Atomic Energy Research Establishment, Harwell, Eng.), from Normy Radiatsionnoi Bezopasnosti (NRB-69), Atomizdat, Moscow, 1970. 66p. Dep. NTIS (U. S. Sales Only). UK 45p.

Basic radiation safety standards adopted in the Soviet Union in 1969 are presented. The standards are based on the recommendations of the International Commission on Radiological Protection (ICRP) as set forth in Publication 9 (1965). (C.H.)

24186 (CEA-N–1408(3)) RADIOACTIVE CONTAMINATION IN WORKSHOPS AND LABORATORIES. VOLUME III. INDIVIDUAL PROTECTION TECHNIQUES. Werderer, Bernard (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Feb 1971. 160p. (In French). Dep. NTIS (U. S. Sales Only).

The general principles concerning the safety of the individual and physiological factors concerning the protection of the respiratory system against radioactive particles are discussed. Protective respiratory apparatus is considered with respect to the protection it affords from the contaminated environment, safety considerations, and comfort. Protective equipment against external contamination (mainly suits) is reviewed. Special pressurized and unpressurized sealed suits are examined in relation to the degree of protection afforded and the working conditions envisaged. The comfort experienced by the wearers is dependent upon the temperature and humidity inside the suits. (France)

24187 (CEA-N–1413) STUDY OF CLOTHES PROVIDING EFFECTIVE TRITIUM PROTECTION. Marteau, Pierre (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Feb 1971. 52p. (In French). Dep. NTIS (U. S. Sales Only).

The manufacture of individual clothes providing maximum protection against tritium and tritiated water vapor was studied. A review of the properties of tritium, its biological effects and the hazards it presents, was made. A thorough investigation of the various polymerized and rubberized materials suitable for making such clothes was carried out. A protective suit of original design, made of the material found to be the most effective in view of the mechanical resistance criteria imposed, was manufactured and tested. Since tritium and tritiated water diffuse very easily through all materials, the use of such clothes may be extended to almost all substances which present chemical or radioactive hazards. (France)

24188 (NP–18727) ANNUAL REPORT TO THE DIRECTOR-GENERAL OF HEALTH FOR THE YEAR ENDED 30 JUNE 1970. (Commonwealth X-Ray and Radium Lab., Melbourne (Australia)). 35p. Dep. NTIS (U. S. Sales Only).

Developments during the year are outlined and activities undertaken are described briefly. These activities include national isotope standardization, standardization of exposure measurements, calibration of clinical dosimeters and measurement of characteristics of hospital x-ray equipment, an advisory service on diagnostic radiology, care and maintenance of radium, radon and radiopharmaceuticals (statistics of handling are tabulated), data collection on environmental radioactive materials, whole-body monitoring, advice and investigations in radiation protection, and a film badge service. Staff activities and publications are listed. (Australia)

24189 DOUBLE SHIELDING FOR RADIUM OPERATIONS. Pantoja, E. (Jewish Hospital and Medical Center, Brooklyn). Radiology; 97: 376(Nov 1970).

Although exposure to radium brought to the operating room is reduced by keeping it inside a lead container, lead shielding of the radium already in the patient is not generally employed. A mobile shield designed to circumvent this difficulty is described. (auth)

24190 ELEVEN STEPS TO SAFER DIAGNOSTIC X-RAY. Kehr, Leon E. (Pennsylvania Coll. of Podiatric Medicine, Philadelphia). J. Amer. Podiat. Ass.; 60: 310-12(Aug 1970).

In making a diagnostic x ray the physician has two objectives namely to obtain a clear picture with good contrast and to protect the patient from over-radiation. One way of protecting the patient is to minimize exposure time. This can be done by getting the best columnization possible from the x-ray machine and by carefully positioning the patient. Suggestions are presented for doing both, as well as for protecting the operator and for obtaining good dark room results. (auth)

24191 GOALS OF RADIATION PROTECTION AND SAFETY REGULATIONS. Brunner, H. (Eidgenoessische Technische Hochschule, Wuerenlingen, Switzerland). Neue Tech., B; 12: 188-94(Dec 1970). (In German).

The principles of radiation protection and regulations are surveyed. Discussed are: natural radiation levels; general goals of radiation protection; international and national organizations for radiation protection; recommendations of the ICRP; the risk concept; acceptable risks; controlled irradiation; accidental irradiation; and practical application of the ICRP recommendations. (H.B.G.)

24192 ESTIMATE OF THE DOSE OF IONOGENIC RADIATIONS ABSORBED BY AIRPORT PERSONNEL CARRYING OUT THE GROUND OPERATIONS CONNECTED WITH THE TRANSPORT OF PACKAGES CONTAINING RADIOACTIVE MATERIALS. Perini, A. (Ispettorato Medico Centrale del Lavoro, Rome); Susanna, A. Securitas; 54: 821-40(1969). (In Italian). (RT/PROT–(70)6).

A study was made of the conditions in which the various operations connected with the air transport of packages containing radioactive materials were carried out. The operations studied included embarkation and disembarkation, handling and storage, as well as acceptance and delivery of the packages, and particular attention was paid to the problems of protecting personnel against radiation. The study showed that the critical group of workers is the one concerned with handling the arriving packages. (auth)

Safety Procedures

Refer also to abstracts 24007 and 25397.

24193 (BRH/DEP–70-26) ELECTRONIC PRODUCT RADIATION AND THE HEALTH PHYSICIST. Health Physics Society Fourth Annual Midyear Topical Symposium, Louisville, Ky., January 28–30, 1970. (Health Physics Society. Blue Grass Chapter.

Bureau of Radiological Health, Rockville, Md. Div. of Electronic Products). Oct 1970. 470p. (CONF-700115). NTIS.

Separate abstracts were prepared for 6 of the 33 papers presented. The remaining 27 papers were not within the scope of NSA. (W.H.K.)

For abstracts of individual papers see: 23903–23905, 23932, 24074, and 24196.

24194 (CEA-CONF-1672) HARMFUL EFFECTS DUE TO THE USE OF FLUORINE IN NUCLEAR INSTALLATIONS. Bittel, R.; Vaubert, B. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1970. 5p. (In French). (CONF-700951–1). Dep. NTIS (U. S. Sales Only).

From 3. European fluorine chemistry symposium; Aix-en-Provence, France (14 Sep 1970).

The origin, nature, and consequences for man and the environment of the harmful effects resulting from the release of fluorine, fluorides, and fluorinated compounds into the environment are discussed. The hazards resulting from the changes brought about in materials by their association with fluorine in the various processes encountered in the atomic industry are analyzed. Harmful effects resulting from fluorine disposal vary with its physiochemical state and the intrinsic properties of the dispersion media. A method is proposed which facilitates control by providing accurate measurements of pollution levels. (France)

24195 RADIATION PROTECTION FOR PLANT AND WORK FIRE DEPARTMENTS. Schenk, M. Maschinenmarkt; 76: 1808-10(1970). (In German).

Protection against hazards originating from the application of nuclear energy must be secured in all plants using radioactive materials. The plant fire brigade is responsible for applicable technical aid. Regulations and standards for plant fire brigades are discussed based on the evaluation of past experience. (INIS)

Legal Aspects

24196 (BRH/DEP–70-26, pp 40-50) THE IMPACT OF THE ELECTRONIC PRODUCT RADIATION CONTROL PROGRAM (P. L. 90-602). Britain, Robert G.; McConeghy, D. J. (Bureau of Radiological Health, Rockville, Md. Div. of Electronic Products).

In Electronic product radiation and the health physicist.

The impact of Public Law 90-622 (1968) for protection of the public against the hazards of electronic products capable of emitting ionizing, non-ionizing, and electromagnetic radiations, sonic, infrasonic, and ultrasonic waves that result from the operation of an electronic circuit in a commercial product is discussed. Microwave ovens, color television sets, x-ray machines, particle accelerators, and lasers are included in the protection program. The requirements for performance standards for all electronic equipment before January 1, 1970 are reviewed briefly. (C.H.)

24197 TREATY OF TLATELOLCO AND THE UNITED STATES: A LATIN AMERICAN NUCLEAR FREE ZONE. Robinson, Davis R. Amer. J. Int. Law; 64: 282-309(Apr 1970).

The provisions of the 1968 Treaty for the Prohibition of Nuclear Weapons in Latin America, often referred to as the Treaty of Tlateloico, are reviewed. The Treaty contains a preamble, 31 articles, and two additional protocols that prohibit the production and deployment of nuclear weapons in Central and South America. The treaty had been ratified by 16 countries as of 1970. (C.H.)

24198 ACTIVITIES OF THE INTERNATIONAL ATOMIC ENERGY AGENCY IN THE INTERNATIONAL FIELD IN RESPECT TO THE APPLICATION OF NUCLEAR TECHNIQUES TO ANIMAL SCIENCES. Knutsson, Per-Goeran (International Atomic Energy Agency, Vienna). Zentralbl. Veterinaermed., Beih.; No. 11, 239-46(1970).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

The Joint FAO/IAEA Division has a special section of animal production and health, the program of which is concentrated on parasitology, mineral metabolism, and mineral dependent diseases. Internationally coordinated research programs were established in both these fields. The scientists taking part in such a program obtain various forms of support, e.g. research contracts, information service, etc. The organization also sponsors meetings for contractors at regular intervals. The IAEA has a large information service and a considerable number of symposia and seminars are arranged every year. (auth)

24199 TREATY ON THE NON-PROLIFERATION OF NUCLEAR WEAPONS. Firmage, Edwin Brown (Univ. of Utah, Salt Lake City). Amer. J. Int. Law; 63: 711-46(Oct 1969).

The Treaty on the Non-Proliferation of Nuclear Weapons was signed by over 50 countries, including the United States, the Soviet Union, and the United Kingdom, on July 1, 1968, at Moscow, Washington, and London. It will enter into force when instruments of ratification have been submitted by the United States, the Soviet Union, and the United Kingdom, plus 40 other governments. The key articles of the treaty are presented and implications of the treaty for the prevention of nuclear war are discussed. (C.H.)

Medicine

Refer also to abstract 24180.

24200 BLOOD SUPPLY TO SKIN GRAFTS AS AFFECTED BY DETRIMENTAL AND PROMOTING FACTORS. Schottke, C.; Krasselt, M.; Andreas, M.; Karbe, M. (Karl Marx Univ., Leipzig). Deut. Stomatol.; 20: 508-12(Jul 1970). (In German).

Critical phases of blood supply to skin grafts that may be due to multiple detrimental factors can be quantified by measuring the circulatory conditions. The use of Elawox powder as a supporting treatment of pedicle flaps with impaired blood supply is recommended. The results obtained with skin grafts performed in cases of irradiation burn are of a prospective nature. Further extensive basic research is needed before the use of circulation-promoting substances or measures can be recommended for irradiation burn. (auth)

24201 FIZYKA MEDYCZNA I ELEMENTY BIOFIZYKI. PODRECZNIK DLA STUDENTOW MEDYCYNY. WYDANIE VI. UZUPELNIONE I POPRAWIONE. (Medical Physics and Elements of Biophysics. A Textbook for Students of Medicine. Sixth, Revised and Supplemented Edition). Adamczewski, Ignacy. Warszawa; Panstwowy Zaklad Wydawnictw Lekarskich (1969). 617p. $3.85.

The problems of biophysics and medical physics are examined. The structure of matter, mechanics, heat, thermodynamics, the electric, magnetic and optical properties of matter, cell biophysics, organ biophysics, the influence of external factors (heat, electric current, light, and ionizing radiation) on the system, as well as measuring methods and instruments used in biophysics and medical physics are discussed. (auth)

24202 2. SYMPOSIUM RADIOAKTIVITAET UND STRAHLENBIOLOGIE IN IHRER BEDEUTUNG FUER DIE VETERINAERMEDIZIN, HANOVER, 19.–21. JUNI 1968. (Second Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, June 19–21, 1968). Beiheft 11 Zum Zentralblatt fuer Veterinaermedizin. Berlin: Verlag Paul Parey (1970). 292p. DM 54,-. (In German and English). CONF-680672).

Forty-three papers are presented. Separate abstracts are prepared for 34 papers. Papers not abstracted for NSA contain information about routine tracer studies in veterinary medicine. (H.B.G.)

For abstracts of individual papers see: 23818, 23900, 24015–24025, 24047–24049, 24080, 24137–24140, 24173, 24198, 24208, 24303, 24304, 24375–24378, 24519–24521, and 26009.

Protective Substances

Refer also to abstracts 24039, 24207, 24348, 24354, 24402, 24409, 24410, 24412, and 24413.

24203 (CEA-R-4110) A STUDY OF THE RADIOPROTECTIVE POWER OF IMIDAZOLE, BENZIMIDAZOLE, AND NAPHAZOLINE ON MICE PLACED IN A PURE OXYGEN ATMOSPHERE. Mourret, Andree; Rinaldi, Renaud (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Jan 1971. 32p. (In French). Dep. NTIS (U. S. Sales Only).

Male and female mice were exposed to ^{60}Co gamma radiation. The LD/100/30 (1050 R) was established and three radioprotective drugs (imidazole, benzimidazole, and naphazoline) were tested in a manner similar to that already used for x rays. The effectiveness was respectively: 65 per cent, 70 per cent, and 90 per cent for females and 25 per cent, 55 per cent, 100 per cent for males. The three substances were then tested on animals living in a pure oxygen atmosphere at pressures between 1.1 and 2.5 atmospheres. The radioprotective power of imidazole and benzimidazole diminished considerably while naphazoline retained its effectiveness. The effectiveness of this drug under these conditions is sensibly equivalent to that of cysteamine which has served as reference for this sort of experiment. (France)

24204 CYSTEAMINE PROTECTION AGAINST LETHAL AND GROWTH-INHIBITING EFFECTS OF PRENATAL X AND GAMMA

IRRADIATION. Roberts, Joan M. (Univ. of Detroit). Teratology; 3: 319-24(Nov 1970).

Exposure of pregnant rats to γ radiation on day 16 of gestation produced nearly double the number of neo- and postnatal offspring deaths as did x irradiation. Dose level (185 R), dose rate (10 to 12 R/minute), and distance from the source were the same in both groups. Cysteamine given prenatally prior to either γ or x irradiation significantly decreased mortality. In the γ-irradiated group the mortality rate remained significantly higher than in the control group, but in the x-irradiated group it was reduced to the control level by pretreatment with cysteamine. Cysteamine given to pregnant rats immediately following γ irradiation had no effect on offspring mortality. (auth)

24205 RADIO-SENSITIZATION WITH EXTRA-CELLULAR HALOGENATED PURINES AND PYRIMIDINES AND RELATED COMPOUNDS. Kada, T.; Sadaie, Y.; Noguti, T. (National Inst. of Genetics, Mishima, Japan). Int. J. Radiat. Biol.; 18: 281-5(1970).

A strain of Bacillus subtilis was used for observations of the radiosensitizing properties of 14 halogenated bases and derivations in acid (pH 5.4) and neutral (pH 7.0) solutions, when exposed to 10 kR γ radiation from a 6000 Ci source of ^{137}Cs at a dose rate of 40 kR per hr. Radiosensitizing effects were observed with 5-iodouracil, 5-iodocytosine, 5-iodouridine, 5-iodo-2'-deoxyuridine, 5-iodo-2'-deoxycytidine and 6-iodopurine, the effects being enhanced at pH 5.4, except for 5-iodouridine. No sensitizing effect was observed with the brominated bases and their derivatives, and in contrast to the iodine compounds, radiation production of persistent toxicity was scarce. A sensitizing effect was observed for 6-chloropurine in neutral solution, enhanced at pH 5.4, and high toxocity was observed with this compound after irradiation in an acid solution. The sensitizing action of the 6-chloropurine riboside was weaker than that of the compound itself. (UK)

24206 EFFECT OF BUTYL ALCOHOL AND DNA HYDROLYSATES ON CHANGES IN SOME BLOOD PARAMETERS IN ANIMALS, IRRADIATED BY FAST NEUTRONS. Chebotar'ov, E. Yu.; Ryabova, E. Z. (Inst. of Physiology, Kiev). Fiziol. Zh., Akad. Nauk Ukr. RSR; 15: 846-8(Nov-Dec 1969). (In Ukranian).

Effects of butyl alcohol and DNA hydrolysates on changes on some blood parameters in animals irradiated by 215 rad fast neutrons were studied using 264 white male rats. The butyl alcohol was introduced per os (0.0016 mg/kg) ten days before exposure and DNA intraperitoneally (0.02 mg/kg) at the same time. The results showed that prophylactic treatments with butyl alcohol and denatured DNA before exposure increased the radioresistance of blood to fast neutrons and DNA stimulated hematopoietic processes. However, treatments with butyl alcohol inhibited hematopoietic processes. (R.V.J.)

24207 CHROMOSOME RADIOPROTECTION IN VITRO: TESTS WITH CYSTEINE AND THIOCTIC ACID. I. Romito, Sandro. Fracastoro; 62: 571-5(Nov-Dec 1969). (In Italian).

Cultures of human bone marrow cells were treated with 400 R x radiation. Cysteine and thioctic acid were added to the cultures and it was found that chromosome damage was reduced by both substances. The radioprotective effect of cysteine was more pronounced than that of thioctic acid. (H.L.W.)

24208 USE OF EPSILON-AMINOCAPROIC ACID AND P-AMINOMETHYLBENZOIC ACID AGAINST THE DISTURBED BLOOD-COAGULATION CAUSED BY IRRADIATION. Pospisil, J.; Skala, E.; Slanina, P.; Dienstbier, Z. (Charles Univ., Prague). Zentralbl. Veterinaermed., Beih.; No. 11, 25-30(1970).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

It was established that the administration of epsilon-aminocaproic acid (EACA) in the dose of 0.4 kg/day per os from the 8th up to 18th day to whole-body irradiated dogs improves partially the post-irradiation disturbance of hemocoagulation. Also confirmed were the same results from a single application of EACA to whole-body irradiated dogs. It was simultaneously found in another group of experimental dogs, which were whole-body irradiated by 600 R, that a significant decrease of EACA resorption from the gastrointestinal tract occurs on the 4th and 8th day after irradiation following pretreatment with this compound per os. The application of para-aminomethylbenzoic acid (PAMBA) to whole-body irradiated dogs with a dose of 600 R did not provide a significant effect upon the improvement of post-irradiation disturbance of hemocoagulation as compared with the administration of EACA. (auth)

24209 IN VITRO RADIOPROTECTION OF GROWING MOUSE BONES. Noel, J. F.; Wright, E. A. (St. Mary's Hospital, London). pp 89-91 of Symposium Ossium. /Jelliffe, A. M. (ed.). London; E. and S. Livingstone (1970).

From Symposium ossium; London (4 Apr 1968).

Dose response curves are presented for mouse tail bones irradiated in the presence or absence of dimethyl sulfoxide (D.M.S.O.) or glycerol, and then transplanted to grow below kidney capsules. Irradiation was in the range 0 to 4,750 Rads, of x rays (220 kV, 15 ma, 0.5 mm Cu and 1 mm Al added filtration). D.M.S.O. and glycerol showed radioprotective properties as measured by the bone growth, and D.M.S.O. enhanced the protection given by anoxia. (UK)

24210 CYCLIC AMP MECHANISM IN THE ACTIONS OF RADIOPROTECTIVE SUBSTANCES. Langendorff, H. (Heiligenberg-Institut, Ger.). Naturwissenschaften; 57: 455(Sep 1970). (In German).

To explain the radioprotective action of compounds with sulfhydryl groups, the following mechanism is suggested: the SH groups react with specific receptors that are localized on the surface of biological membranes. As a result of complex formation, the receptors are activated; they probably represent a subdivision of the adenylcyclase system bound to the membrane. In the presence of Mg^{2+}, adenylcyclase is stimulated and leads to increased formation of cyclic AMP and pyrophosphate from ATP. Experimental observations, favoring such a concept, are listed. (H.B.G.)

24211 REDUCTION IN THE ABSORPTION OF DIETARY STRONTIUM IN CHILDREN BY AN ALGINATE DERIVATIVE. Sutton, Alice (Medical Research Council, Harwell, Eng.); Harrison, G. E.; Carr, T. E. F.; Barltrop, D. Int. J. Radiat. Biol.; 19: 79-85(1971).

The plasma concentration and urinary excretion of a stable strontium marker (^{84}Sr) taken with meals with and without a derivative of sodium alginate, OG1, was measured in 10 children from 2½ to 14 years of age by neutron activation analysis. As in adults, the alginate preparation reduced the absorption and retention of strontium about 4-fold and, in the amounts given, had little effect on the absorption of calcium. (auth) (UK)

24212 EXPERIMENTAL STUDIES IN LOCAL RADIOPROTECTION OF THE SKIN. Rajnov, A.; Cocev, C. Nauch. Tr. Vissh. Med. Inst., Sofia; 47: No. 4, 23-32(1968).

The local protective action against radiation injuries of the skin was studied for the following substances: aqueous extract of Acanthium; escuvasin; a combination of adrenaline, novocaine, acetylcholine, and lanolin; Lambraten ointment; ointment containing thyroid gland extract; AET ointment; ointment containing AET, apitonin, and lanolin; and a combination of Lambraten with thyroid gland extract and apitonin. Some of the substances were rubbed in only once, and others three times. The separate substances exhibited different protective effects. The weakest radioprotective action was manifested by escuvasin and the strongest by the combination of Lambraten, thyroid gland extract; and apitonin. (Abstr. Bulg. Sci. Med. Lit.)

24213 RADIATION PROTECTIVE SUBSTANCES. Akaboshi, Sanya (National Inst. of Radiological Sciences, Chiba, Japan). Yuki Gosei Kagaku Kyokai-Shi; 28: 807-19(Aug 1970). (In Japanese).

Data are reviewed on some chemical compounds which have a protective effect against radiation injury when they are administered before exposure. The various kinds of chemical protector are tabulated. Among them, 2-aminoethyl isothiouronium compounds (AET), cysteamine (MEA), and serotonin are representative chemical protectors. The chemical change of AET type compounds due to the pH of solution, the efficacy test of chemical protectors, the syntheses of AET and its derivatives, the protective effect of AET related compounds against radiation, the relation between chemical structure and the protective effect against radiation, and the syntheses of cysteamine compounds and other radiation protective compounds are described. (Japan)

24214 EFFECTS OF SOME RADIOPROTECTIVE SUBSTANCES ON THE NADH-CYTOCHROME C-REDUCTASE ACTIVITY OF ISOLATED LIVER MITOCHONDRIA. Pora, E. A.; Abraham, A. D.; Uray, Z.; Maniu, Mariana; Farcasanu, M. (Biological Research Centre, Cluj. Inst. of Cancer, Cluj). Rev. Roum. Biol., Ser. Zool.; 15: 165-8(1970).

Some neurotrope substances, sulphamides, biogenous amines, and AET can influence the respiratory activity of isolated liver mitochondria by interaction with NADH-cytochrome C reductase. It was proven that the moderate reduced state of respiratory enzymes may ensure radioprotection, a phenomenon that can explain the radioprotective effect of these substances. (auth)

XUM

24215 INFLUENCE OF THE INTERVAL BETWEEN ADMINISTRATION OF RADIOPROTECTOR AND BEGINNING OF WHOLE-BODY IRRADIATION ON PROTECTIVE EFFECT, THE EVALUATION BY WEIGHT LOSS OF SUBMAXILLARY GLANDS. Vodicka, I.; Petyrek, P. Sb. Ved. Pr. VLVDU Hradci Kralove; 43: 31-44(1969). (In Czech).

The influence of the interval between i.p. administration of cystamine, tetramethylcystamine, and AET, and the beginning of whole-body gamma irradiation on the protective effect of these compounds were studied in female rats using the postirradiation weight loss of submaxillary gland as an indicator of radiation damage. Cystamine afforded the best protection when administered 10 minutes before irradiation, 20 minutes after administration and later the protection disappeared completely. The tetrine protection exhibits two types of action: 30 minutes and 80 to 90 minutes after i.p. administration. (auth)

24216 ACUTE CHEMICAL TOXICITY AND RADIOPROTECTIVE EFFECTIVENESS OF CYSTAMINE COMBINED WITH AET OR SEROTONIN. Dostal, M. Sb. Ved. Pr. VLVDU Hradci Kralove; 43: 93-185(1969). (In Czech).

In combinations of cystamine and AET, injected intraperitoneally in mice, neither acute chemical toxicity, nor radioprotective effectiveness against single supralethal exposure was found to be changed. In a mixture of cystamine and serotonin the acute toxicity of cystamine was slightly greater than in cystamine alone. The protective effect of both agents, first of all in the range of ED_5 to ED_{50}, was found to be remarkably increased. (auth)

24217 RADIOPROTECTIVE AND ACUTE TOXIC EFFECTS OF CYSTAMINE, 5-METHOXYTRYPTAMINE AND THEIR COMBINATIONS IN MICE. Dostal, M.; Mencl, J. (Purkyne Medical Research Inst., Hradec Kralove, Czech.). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 29-30(1970). (In English and Czech).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

Mice were irradiated with doses of 900 to 1300 R and the radioprotective and toxic effects of cystamine, 5-methoxytryptamine, and their combination in various proportions were investigated. An increased survival of irradiated mice was seen with a 3:1 mixture; also the acute toxicity was lowered in unirradiated mice. These effects were not observed with other drugs similarly analyzed. (F.M.M.)

24218 RADIOPROTECTIVE EFFECT OF A MIXTURE OF CYSTAMINE AND 5-METHOXYTRYPTAMINE ON ENDOGENOUS SPLEEN COLONY-FORMING UNITS IN GAMMA-IRRADIATED MICE. Dostal, M.; Petyrek, P.; Mencl, J. (Purkyne Medical Research Inst., Hradec Kralove, Czech.). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 31-8(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

The method of endogenous spleen colonies was used for estimation of the protective effect of cystamine simultaneously combined with 15-methoxytryptamine (5-MT). The protection afforded by cystamine was increased when injected in a mixture with 5-MT intraperitoneally 6 to 4 min prior to the lethal or supralethal exposures. The effect of the mixture (in the proportion 3:1 of free bases) given in reduced doses is superior to the cystamine or 5-MT alone administered in the optimal protective dosage. (auth)

24219 UPTAKE OF ^{32}P IN MYOCARDIUM OF UNPROTECTED AND CYSTAMINE PROTECTED RATS AFTER WHOLE BODY GAMMA IRRADIATION. Kuna, P. (Purkyne Medical Research Inst., Hradec Kralove, Czech.). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 137-42(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

In unprotected and cystamine-protected rats whole-body γ irradiated with 700 R (35 R/min), the content of total acid-soluble phosphorus in heart tissue as well as ^{32}P incorporation at three hour intervals remained unchanged on the 1st, 4th, 6th and 10th day following irradiation. (auth)

24220 EFFECT OF CYCLOPHOSPHAMIDE ON WHOLE-BODY IRRADIATED MICE BEFORE AND AFTER TREATMENT WITH THE ALLOGENEIC OR XENOGENEIC BONE-MARROW. Petyrek, P. (Purkyne Medical Research Inst., Czech.). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 167-74(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

The application of cyclophosphamide in a dose of 100 mg/kg either immediately or 24 hours following whole-body irradiation and in a dose of 50 mg/kg from the 6th till the 9th day after whole-body irradiation with 900 R had no effect on the survival of experimental animals. Whole-body irradiation of mice with 900 R decreased the immune reactions. The application of cyclophosphamide before allogeneic bone marrow had no effect. The application of cyclophosphamide immediately after transplantation of allogeneic bone marrow and on the 6th till the 9th day following irradiation in doses of 100 mg/kg and 50 mg/kg had a favorable effect on the survival of experimental animals. The application of xenogeneic bone marrow cells and cyclophosphamide had no effect on the survival of experimental animals. (auth)

24221 PHARMACOLOGY AND PHARMACODYNAMICS OF ELLAGIC ACID IN HEALTHY AND IRRADIATED ANIMALS. Pospisil, J., Zitko, M., Klir, P.; Skala, E.; Dienstbier, Z. (Charles Univ., Prague. Central Hospital, Prague). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 183-6(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

The preparation and pharmacological tests on ellagic acid are described. Results of administration of ellagic acid to healthy animals are described. Ellagic acid was also administered to while-body irradiated mice with doses of 500 and 700 rad. No effect on the death rate was observed. It was found that the amount of ellagic acid excreted in urine after intravenous administration into healthy animals did not differ from that excreted by whole-body irradiated rats that had received the compound on the 11th day after irradiation. (F.M.M.)

24222 EFFECT OF SOME VASOACTIVE IONS IN THE LOCAL PROTECTION AGAINST THE DEPILATORY ACTION OF X-RAYS IN YOUNG MICE. Pospisil, M.; Netikova, J. (Inst. of Biophysics, Brno). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 187-92(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

Mice were given a whole-body dose of 550 R of x rays. The protective effects of the following vasoactive ions, Na, Li, K, Rb, Cs, and Ca, against depilation were tested, also the effects of pH within the range 6.2 to 8.6. The highest protective effect was exhibited by K and Ca, a less marked effect by Rb and Cs and no marked effect by Li and Na. In regard to pH, the highest protective effect was exhibited by alkali reactions with a maximum about pH 8.2. The relation of the protective action to vasoconstriction is discussed. (F.M.M.)

24223 EFFECT OF SOME DRUGS AFFECTING THE GASTROINTESTINAL MOTILITY OF GASTRIC EMPTYING IN IRRADIATED MICE AND RATS. Visnovsky, P.; Grossmann, V.; Horackova, O.; Pikolova, V.; Kopalova, A. (Charles Univ., Hradec Kralove, Czech.). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 267-74(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

Arecoline was the only drug used that showed a significant stimulating effect on gastric emptying in irradiated mice. However, it failed to influence this disturbance in rats, where besides impaired motility, digestive disturbances were present. In rats, some method eliminating the distortion due to non-digested food has to be developed. Only by applying such a method can more exact results be obtained. (auth)

24224 INACTIVATION OF THE PHAGE BY N,N-DIMETHYL-2-CHLOROETHYLAMINE AND THE EFFECT OF PROTECTIVE SUBSTANCES. Vizdalova, M. (Inst. of Biophysics, Brno). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 275-82(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

Single and double stranded phages were treated with the radiomimetic agent, 2-chloro-N,N-dimethylethylamine. All were inactivated but differences in sensitivity were observed. Double stranded phages T_4 and λcb_2 were more sensitive when compared with single stranded DNA phage ϕX174 and RNA phage fr. The effects of 2-chloro-N,N-dimethylethylamine concentration and pH were also studied. The protective effects of the following chemicals, cysteamine, cysteine, AET, tryptamine, dopamine, and EDTA were investigated. A marked protective effect was observed with cysteine, cysteamine, and AET, a weak protective effect with EDTA, and no protective effect with tryptamine and dopamine. (F.M.M.)

Radiation Sickness and Injuries

Refer also to abstract 23946.

24225 (AEC-tr-7195, pp 439-58) REMOTE SEQUELAE OF RADIATION DAMAGE. Moskalev, Yu. I.; Strel'tsova, V. N.; Lemberg, V. K. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

A review is presented on the remote sequelae of radiation damage. The characteristics of nontumorous forms that developed in rats following the incorporation of ^{90}Sr, ^{210}Po or total external irradiation by protons and neutrons are described. The characteristics of the tumorous forms of remote sequelae were obtained on the basis of analysis of experiments with a single irradiation of rats by protons and neutrons, or the incorporation of various radioisotopes. Attempts at therapeutic action on the irradiated body in order to study the effects of certain factors on radiation carcinogenesis as one of the forms of remote sequelae demonstrated the possibility of suppression or stimulation of the blastomatogenous reaction. Studies were also conducted on the effects of such factors as inflammation, fracture, and bleeding to determine their effect on radiation injury. Results indicated that they do affect certain forms of radioinduced carcinogenesis. Factors effecting chromosome aberrations in tissue cells are also discussed. (E.E.H.)

24226 RADIOPROTECTIVE EFFECT OF TAURINE DURING RADIOTHERAPHY. Nishida, Hisao; Tanabe, Masaya (National Hospital, Kyoto). Rinsho Hoshasen; 15: 672-6(Sep 1970). (In Japanese).

In 23 cancer patients whose leukocyte count decreased below 4,000 during radiotherapy, taurine was administered orally at a daily dose of 3,000 mg, and was continued until the completion of radiotherapy. As a result, there was no case in which radiotherapy had to be discontinued on account of leukopenia. After the administration of taurine, white cell count, red cell count, and hemoglobin content all increased, and thrombocyte count did not decrease, in spite of the continuation of the radiotherapy. Furthermore, the side effects of taurine were negligible. (Japan)

24227 EFFECT OF DIAZEPAM ON THE TOXICITY OF CARDIAZOLE DURING THE ACUTE RADIATION SICKNESS. Simkova, M.; Kvetina, J.; Prokesova, V. (Charles Univ., Hradec Kralove, Czech.). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 229-34(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

The anticardiazolic effect of diazepam administered intravenously to mice was tested in the course of radiation sickness on the 3rd day and 6th days after a single dose of 600 R on the basis of the LD 50 or the drug. The toxicity of cardiazole alone after intravenous administration was slightly diminished after irradiation on the 3rd day after exposure. The effects of diazepam increased significantly at both post-irradiation intervals. (auth)

Radiodiagnosis

Refer also to abstracts 23773, 23779, 23798, 23804, 23924, 24004, 24032, 24126, 24177, 24190, 24375, and 24450.

24228 (BRH/DBE-70-8) DIAGNOSTIC RADIATION UTILIZATION IN SELECTED SHORT-TERM GENERAL HOSPITALS. Hemphill, Fay M.; Locke, Frances B.; Hesselgren, Rudolph D. (Public Health Service, Rockville, Md. Radiological Health Lab.). Dec 1970. 52p. Dep. NTIS.

Two million patient hospital-stay records were studied annually for 1963, 1966, and 1968 from more than 200 selected general hospitals to estimate trends of diagnostic medical radiation. The data on the utilization patterns of ten diagnostic radiation categories showed a significant annual increase of discharged patients who received any diagnostic radiation, and increased utilization of multiple categories per discharge. Significant changes were found in utilization of specific radiation categories. Patterns of utilization differed markedly by age, discharge diagnosis, and hospital size. After adjustment for hospital population changes, utilization of any diagnostic radiation showed increases of 1% annually. (auth)

24229 (BRH/DMRE-70-3) A TRAINING MANUAL FOR NUCLEAR MEDICINE TECHNOLOGISTS. Simmons, Guy H. (Bureau of Radiological Health, Cincinnati, Ohio. Div. of Medical Radiation Exposure). Oct 1970. 221p. GPO $1.75.

This manual was prepared for use in the didactic portion of a training program in nuclear medicine technology. Topics covered include the physics and instrumentation associated with the use of radionuclides in medicine as well as a brief outline of nuclear medicine studies. (C.H.)

24230 COMPUTER ALGORITHMS FOR THE DETECTION OF BRAIN SCINTIGRAM ABNORMALITIES. Lehr, James L. (Univ. of Missouri, Columbia); Parkey, Robert W.; Harlow, Charles A.; Garrotto, Lewis J.; Lodwick, Gwilym S. Radiology; 97: 269-76(Nov 1970).

Algorithms for computer analysis of digitized brain scintigrams are described. A technique of variable thresholding and region enumeration was used to detect abnormalities which project clear of the calvarium, while a metric comparison detects distortions of the brain outline. The methods were employed to process scintigrams digitized by means of an image dissector camera operating under control of an SEL-840A computer. It was felt that the algorithms will be equally applicable to brain scintigrams digitized by other means and that they may prove adaptable to the analysis of other organ system images. (auth)

24231 COMPUTER ASSISTANCE IN THE INTERPRETATION AND QUANTIFICATION OF LUNG SCANS. Strauss, H. William; Natarajan, T. K.; Sziklas, John J.; (and others) (Johns Hopkins Medical Institutions, Baltimore). Radiology; 97: 277-81(Nov 1970).

Three methods for quantification of perfusion defects on lung scans were compared. In the subjective, five expert observers estimated the perfusion defect by simple inspection; in the semi-objective, a densitometer and planimeter measured the extent of lesions identified by experts. This proved tedious and produced poor results with differences in technique of scan performance. Computer-assisted image display and analysis (IDA) system stored original data and permitted optimization of images and made possible simple, rapid quantification. With the computer, novices could perform better than experts using the subjective method; even for small perfusion defects relative standard deviation was less for the computer-assisted method than for the subjective. (auth)

24232 ^{99m}Tc SULFUR COLLOID MACROAGGREGATES. A NEW LUNG-SCANNING AGENT. Ficken, V.; Halpern, S.; Smith, C. Jr.; Miller, L.; Bogardus, C. Jr. (Univ. of Oklahoma, Oklahoma City). Radiology; 97: 289-95(Nov 1970).

Manufacture of ^{99m}Tc sulfur colloid macroaggregates was achieved by modification of the method used to form ^{99m}Tc sulfur colloid, followed by glutaraldehyde stabilization of the radiopharmaceutical. Nearly 100% of the pertechnetate ion is incorporated into particles, varying from 10 to 40 μ in diameter, stable on routine handling, with effective half-time in lungs of 120 hrs. Approximately 96% of the particles were initially distributed throughout the lungs and, upon clearance, distributed themselves throughout the reticulo-endothelial system. Animal and human studies revealed no evidence of pulmonary pathology, chemical toxicity, pyrogenicity, liver disease, hypersensitivity, or altered lung physiology after injection of particles. (auth)

24233 BRAIN SCANS IN MULTIPLE SCLEROSIS. Gize, Raymond W.; Mishkin, Fred S. (Indiana Univ., Indianapolis). Radiology; 97: 297-9(Nov 1970).

Brain scans were abnormal, suggesting tumor, in five of 28 patients with the clinical diagnosis of multiple sclerosis. All were obtained in patients with active disease; none of the 14 scans in patients with inactive disease were abnormal. In all cases the abnormal uptake lay within the white matter. (auth)

24234 SPLENIC MASSES DETECTED BY SCINTILLATION IMAGING AND CONTRAST TOMOGRAPHY. Morgan, Harry; Johnson, Philip M. (Columbia Univ., New York). Radiology; 97: 301-6(Nov 1970).

Scintillation imaging detected intrasplenic masses in four patients with splenomegaly. Contrast infusion tomography of the spleen, a new diagnostic procedure, provided further morphological information in these patients. The combination of the two procedures allowed differentiation of solid and cystic masses. The masses resulted from an epidermoid cyst of the spleen in two cases and from an apparently solitary metastasis in a third. In the fourth, the lesion presumably represented a benign calcified granuloma. The usefulness of splenic scintillation imaging and contrast infusion tomography is emphasized for the evaluation of patients with splenomegaly and left upper quadrant lesions. (auth)

24235 ADVANTAGES OF ^{99m}Tc PERTECHNETATE FOR THYROID SCANNING IN PATIENTS WITH DECREASED RADIOIODINE UPTAKE. Strauss, H. William; Hurley, Peter J.; Wagner, Henry N. Jr. (Johns Hopkins Medical Institutions, Baltimore). Radiology; 97: 307-10(Nov 1970).

Technetium-99m pertechnetate was compared to ^{131}I iodide for thyroid scanning in 56 patients whose twenty-four-hour uptake of ^{131}I was less than 15% of the dose. ^{99m}Tc provided better resolution of glandular morphology than ^{131}I in 46%; the standard of both scans was equal in 36%, while the ^{131}I scan was better in 18%. When the ^{131}I image was better, the difference was usually only marginal, whereas ^{99m}Tc frequently was markedly superior. In patients with low iodine uptakes, as in the general population undergoing thyroid scans, combining a small dose of radioiodine for the uptake determination with a dose of ^{99m}Tc pertechnetate for the scan appeared preferable. (auth)

24236 DETECTION OF CAROTID ARTERY OBSTRUCTION BY INTRAVENOUS RADIONUCLIDE ANGIOGRAPHY. Griep,

XUM

Robert J.; Wise, Gary; Marty, Raymond (Swedish Hospital Medical Center, Seattle). Radiology; 97: 311-16(Nov 1970).

Radioisotope angiography, using 15 mCi of ^{99m}Tc injected intravenously, was performed on 49 patients also studied by four-vessel arteriography and ophthalmodynamometry. All patients showed symptoms of cerebrovascular disease in the distribution of the carotid or middle cerebral artery. There was less radioactivity for an interval of 6 sec in the region of an obstructed or common carotid artery, as was demonstrated by radiocontrast arteriography, in 11 of 14 patients. No detectable difference in carotid radioactivity was present in one patient with bilateral occlusion and two patients with bilateral stenosis of the carotid arteries. (E.E.H.)

24237 DIAGNOSTIC VALUE OF HEPATIC PLIABILITY AS ASSESSED FROM INSPIRATION AND EXPIRATION VIEWS ON THE GAMMA CAMERA. Kranzler, Jeffery K.; Vollert, Jeanette M.; Harper, Paul V.; (and others) (Univ. of Chicago). Radiology; 97: 323-6(Nov 1970).

The first evaluation of the diagnostic significance of the phenomenon called hepatic pliability is presented. Results showed that anterior views of the liver can be produced with about 100,000 counts in 20 sec or less by using multimillicurie amounts of ^{99m}Tc sulfur colloid and the Anger camera. If obtained in full expiration and inspiration, these show change in hepatic shape or pliability. Among a series of 75 proved cases, lack of pliability reliably indicated abnormality. (auth)

24238 CEREBRAL SCINTIGRAPHY WITH ^{99m}Tc FOR THE DIAGNOSIS OF LARGE SUBTENTORIAL LESIONS WITH THE USE OF OBLIQUE POSTERIO-ANTERIOR PROJECTION. Bozzao, L.; Bava, G. L. (Univ., Rome). Nunt. Radiol.; 35: 117-26(Feb 1969). (In Italian).

Pertechnetate labeled with ^{99m}Tc was used for scanning to test the role of oblique back projection in the investigation of the posterior cranial fossa. Eight cases of space-occupying subtentorial lesions which had been correctly diagnosed with the use of that projection are discussed. (auth)

24239 RADICULOGRAPHIC INVESTIGATIONS WITH THE N-METHYLGLUCAMINE SALT OF IOTHALAMIC ACID. Signorini, E.; Quattrini, A.; Cianchetti, C.; Chiurulla, C. (Univ., Perugia, Italy). Nunt. Radiol.; 35: 103-15(Feb 1969). (In Italian).

After a critical analysis of the techniques that have been used to roentgenologically investigate lumbar and sacral subarachnoidal spaces, the characteristics that are indispensable to the opaque compound to be used for radiculography are outlined. The chief clinical and experimental contributions concerning the use of the N-methylglucamine salt of iothalamic acid were surveyed. A technique is described and the outstanding clinical results and lack of complications are stressed. In particular, there was success in preventing the opaque-compound from rising up to brain cisternae, where it could give rise to severe irritative phenomena with seizure-type clinical manifestations. (auth)

24240 DIAGNOSIS AND TREATMENT OF SOME ACUTE AND SUBACUTE THYROIDITIS WITH RADIO-ACTIVE IODINE. Ouchev, Iv.; Cheyretova, H. (Institut Superieur de Medecine, Sofia). J. Radiol., Electrol., Med. Nucl.; 50: 143-4(Mar-Apr 1969). (In French).

The diagnosis of thyroiditis, an inflammatory disease consecutive to influenza, sore-throat, etc., is often difficult in spite of the fact that the acute onset and anamnesis may lead to its recognition. Ten cases were studied with the aid of radioactive iodine or phosphorus 32. These techniques resulted in a more accurate diagnosis and a marked therapeutic effect was also observed. Doses of 150 to 200 microcuries were effective in restoring the normal functioning of the thyroid and in the scanning technique. (auth)

24241 SCINTIGRAPHIC DIAGNOSIS AND LABORATORY FINDINGS IN DIFFUSE HEPATIC DISEASES. Deininger, H. K.; Heuck, F. (Katharinenhospitals, Stuttgart). Fortschr. Geb. Roentgenstr. Nuklearmed.; 114: 108-19(Jan 1971). (In German).

The value of liver scanning in diffuse hepatic disease was assessed in 92 scans carried out under standard conditions. The results of scanning were compared with the chemical findings. A correlation could not be established. Laboratory methods proved more informative than the scans, but the latter were able to provide some additional information. The features that are found are a change in the colloid distribution in the liver, changes in shape and abnormal size and increased extra-hepatic radiogold deposition. If two such pathological findings are present, there is a high probability, indicated by the scan, that the liver was damaged. (Editor)

24242 IMPLICATIONS OF RENAL SCINTIGRAPHY. Nuic, M.; Hundeshagen, H. (Medizinische Hochschule, Hanover). Fortschr. Geb. Roentgenstr. Nuklearmed.; 114: 32-42(Jan 1971). (In German).

The findings on renal scanning, performed with ^{197}Hg-chlormerodrin, in 1,200 patients with a known diagnosis are analyzed. Scanning defines the extent and localization of parenchymal destruction and demonstrates functional tissues in each kidney. There is high correlation with the clinical diagnosis in every type of disease. Focal parenchymal abnormalities in the cortex which are difficult to diagnose by other methods can usually be shown by scanning. The method is therefore a valuable addition to the available means of diagnosing renal disease. (Editor)

24243 SYMPOSIUM OSSIUM. Proceedings of a Symposium on Bone Lesion Radiodiagnosis and Radioinduction, London, April 4–6, 1968. Jelliffe, A. M.; Strickland, B. (eds.). London; E. and S. Livingstone (1970). 340p. Pound 6. (CONF-680435).

The symposium was divided into 23 sessions; detection of metastases in bone, scanning in bone diseases, angiography, dosimetry in bones and bone marrow, joint diseases, cell biology of bone and bone marrow, joint diseases, experimental studies, osteosarcoma, measurement of bone mineral in vivo (1), giant cell tumors, endocrine bone disease, Ewing's tumor and reticulum cell sarcoma, radiation induced tumors, pediatric bone diseases, measurement of bone mineral in vivo (2), trauma and allied conditions, measurement of bone mineral in vivo (3), tracer studies in bone metabolism, metabolic bone diseases, diagnostic aspects of bone tumors, miscellaneous bone diseases, distribution and incidence of bone tumors. Ninety three papers were presented in the proceedings of which abstracts were prepared for fourteen. A further fifty three papers were presented by title only. (UK)

For abstracts of individual papers see: 24013, 24014, 24174–24177, 24209, 24244, 24245, 24373, 24374, and 24440–24442.

24244 CLINICAL RESULTS WITH REACTOR PRODUCED ^{18}F. Zum Winkle, K.; Maier-Borst, W.; Harbst, H.; Scheer, K. E.; Sinn, H.; Lorenz, W. J. pp 19-21 of Symposium Ossium. /Jelliffe, A. M. (ed.). London; E. and S. Livingstone (1970).

From Symposium ossium; London (4 Apr 1968).

Bone scans using ^{18}F and ^{87m}Sr were performed on 146 patients with benign bone lesions, and the results are tabulated. The procedure was found to involve no risk to the patient, and the radiation dose was low. (UK)

24245 SCANNING OF BONE TUMOURS BY MEANS OF DOUBLE ISOTOPES (^{85}Sr AND ^{197}Hg-, ^{203}Hg-NEOHYDRIN). Torti, G. (Verona City Hospital, Italy). pp 22-5 of Symposium Ossium. /Jelliffe, A. M. (ed.). London; E. and S. Livingstone (1970).

From Symposium ossium; London (4 Apr 1968).

The scans showed different aspects depending on the particular kind of distribution and uptake of the two tracers. ^{85}Sr localized with increased intensity in the part of the tumor where the changing bone process was more active, whereas ^{197}Hg localized within the tumor tissue. This localization occurred in both benign and malignant lesions. (UK)

24246 PREPARATION OF RADIOACTIVE HYDROXYMERCURY DERIVATIVES OF THE FLUORESCEIN SERIES APPLICABLE AS IDRS. Ratusky, J. (Inst. of Organic Chemistry and Biochemistry, Prague); Kronrad, L.; Malek, P.; Vavrejn, B.; Kolc, J. Radiochem. Radioanal. Lett.; 6: 63-71(10 Feb 1971).

The preparation of pure radioactive hydroxymercury–^{197}Hg or ^{203}Hg-derivatives of the fluorescein series, which gave reproducible results in biological tests, is described. The specific radioactivity of these substances is 0.1 to 1 mCi/mg. (auth)

24247 INTERNATIONAL CONFERENCE ON RADIOACTIVE ISOTOPES IN PHARMACOLOGY, GENEVA, 20–23 SEPTEMBER 1967. Waser, P. G.; Glasson, B. (eds.). New York; John Wiley and Sons Ltd. (1969). 498p. (In English and French). (CONF-670998).

Papers, reports and communications presented at the conference are included under the following headings: problems of synthesis and methodology, autoradiography and electron microscopy, specific receptors, and biochemical and pharmacological mechanisms. Separate abstracts were prepared for seven of the reports. (M.C.G.)

For abstracts of individual papers see: 23520, 23529, 23530, 23539, 23574, 23639, and 23941.

24248 UPTAKE OF ^{85}Sr BY AN OSTEOSARCOMA METASTATIC TO LUNG. Schall, Gerald L.; Zeiger, Louis; Primack, Aron; De Lellis, Ronald (National Institutes of Health, Bethesda, Md.). J. Nucl. Med.; 12: 131-3(Mar 1971).

A case is presented of a patient with an osteosarcoma of the femur in whom a ^{85}Sr bone scan confirmed the presence of func-

tioning metastases within the lungs. The areas of concentration corresponded to the calcified lesions which were seen on the chest x ray. Strontium-85 scintiscanning may prove to be a useful procedure for detecting soft tissue metastases in patients with primary osteosarcomas. (auth)

24249 BRAIN SCANNING IN THE DIAGNOSIS OF ASTROCYTOMAS OF THE BRAIN. Moreno, Jose B.; DeLand, Frank H. (Johns Hopkins Medical Institutions, Baltimore). J. Nucl. Med.; 12: 107-11(Mar 1971).

The clinical and diagnostic characteristics of 80 patients with astrocytomas of the brain were evaluated. The neurological findings suggested the possibility of a brain tumor in every case. Seizures and papilledema were more commonly associated with the low-grade astrocytomas; motor weakness and mental deterioration with the high-grade tumors. The incidence of papilledema was appreciably less than has been previously reported. The accuracy of brain scanning and arteriography was similar for the detection of astrocytomas; both were relatively poor for low-grade tumors and acceptable for high-grade. The correct diagnosis was established in 99% of the cases when air contrast studies were done in addition to scanning and arteriography. The histologic variations in these tumors (other than dedifferentiation) did not appear to correlate with the ability of the tumor to concentrate radionuclides. (auth)

24250 DETERMINATION OF CARDIAC OUTPUT BY RADIOISOTOPE ANGIOGRAPHY AND THE IMAGE-INTENSIFIER SCINTILLATION CAMERA. Burke, Gerald; Halko, Arlene; Peskin, Gerald (Univ. of Chicago). J. Nucl. Med.; 12: 112-16(Mar 1971).

Findings are reported that indicate that accurate quantitative assessment of cardiac output can be obtained by an external monitoring isotopic method with a scintillation camera that need not involve cardiac catheterization. Use of ^{99m}Tc-albumin by systemic injection of dogs and patients caused no untoward side effects of hemodynamic disturbances. Studies are presently under way in patients with intracardiac shunts to determine the potential and limitations, if any, of this approach. (auth)

24251 FULL-SIZE SCINTIPHOTOGRAPHY IN PERICARDIAL EFFUSION DIAGNOSIS. Wilcox, F. W.; Ripple, R. C.; McHenry, M. M.; Edgar, W. H. (Sutter Hospitals Medical Research Foundation, Sacramento, Calif.). J. Nucl. Med.; 12: 134-5(Mar 1971).

The Cinto-Photo Enlarger Attachment was used on an Anger scintillation camera to produce full size x-ray scintiradiographs. These full-size emission and transmission scintiradiographs were exactly superimposed and observed on an x-ray film viewer for spatial evaluation. Serial scintiphotographs were obtained at 2 sec intervals following intravenous administration of ^{99m}Tc-pertechnetate. They showed an unusually large area of reduced radioactivity in the left lateral pericardial space. A blood clot was found in this area at surgery. (E.E.H.)

24252 LIVER AND LUNG SCINTIPHOTOS FOR THE DETECTION OF SUBDIAPHRAGMATIC ABSCESS: AN EASY TECHNIQUE. Gallamore, Gary D. (Jersey Shore Medical Center, Neptune, N. J.). J. Nucl. Med.; 12: 144-5(Mar 1971).

The technique described can be used by every hospital currently performing liver scans with ^{99m}Tc–sulfur colloids and lung scans with ^{131}I–macroaggregated albumin using a gamma scintillation camera. (E.E.H.)

24253 STOMACH UPTAKE SIMULATING TUMOR FOLLOWING THE INTRA-ARTERIAL INJECTION OF ^{75}Se-SELENOMETHIONINE. Quinn III, James L.; Nudelman, Earl J.; Cummins, George (Northwestern Univ., Chicago, Chicago Wesley Memorial Hospital). Radiology; 98: 341-2(Feb 1971).

Active anabolic structures have been reported to extract an increased amount of radioselenomethionine when the material is introduced into the afferent blood supply of the organ or region. In the case presented, the gastric fundus took up an unexpectedly large quantity of activity and was mistaken for an intra-abdominal tumor. The celiac arteriogram showed a marked blush in the stomach fundus. A laparotomy revealed no abnormalities. (auth)

24254 THREE-DIMENSIONAL RADIONUCLIDE IMAGING: STEREOSCINTIPHOTOGRAPHY. Charkes, N. David (Temple Univ., Philadelphia). Radiology; 98: 335-9(Feb 1971).

Stereoscopic views of body organs containing radioactive nuclides were made with the Anger camera in more than 160 patients. Satisfactory stereoscintiphotographic images were made of a variety of conditions but proved to be most useful in the clinical evaluation of brain tumors. This technique was also helpful in determining the depth and function of thyroid nodules. (auth)

24255 CHARACTERIZING BRAIN LESIONS WITH USE OF TRANSVERSE SECTION SCANNING. Kuhl, David E.; Sanders, Theodore P. (Univ. of Pennsylvania, Philadelphia). Contract AT(30-1)-3175. Radiology; 98: 317-28(Feb 1971).

In a series of 1,536 patients, image-separating properties of the transverse section scan increased detection specificity and sensitivity and also improved topographic description and evaluation of lesions. The section method demonstrated medial boundaries of lesions, often obscured in the rectilinear views because of radioactivity in overlying venous sinuses and underlying basal structures, helped confirm presence or absence of multicentric uptake, showed lesion shape in transverse plane, allowed side-to-side comparison of asymmetric surface lesions and demonstrated depth of involvement beneath the surface, and permitted a better appreciation of regional differences in growth and vascularity within a lesion. (auth)

24256 INFINITE NUMBER OF LAMINAGRAMS FROM A FINITE NUMBER OF RADIOGRAPHS. Miller, Earl R.; McCurry, Edward M.; Hruska, Bernard (Univ. of California, San Francisco). Radiology; 98: 249-55(Feb 1971).

A technique that can produce an infinite number of laminagrams from a finite number of radiographs is described. The process involves taking a series of radiographs of an object from different angles, while the films bear a constant relation to the object. The resulting films are photographed on a composite photograph so that only one plane is in register. An infinite number of such planes can be chosen. The advantages and disadvantages of laminagraphy by the photographic process are discussed. (auth)

24257 CLINICAL EXPERIENCE WITH THE MULTIPLANE TOMOGRAPHIC SCANNER. Volpe, Joseph A.; McRae, James; Anger, Hal O. (Univ. of California, Berkeley. Letterman General Hospital, San Francisco). J. Nucl. Med.; 12: 101-6(Mar 1971).

One hundred and sixty-one patients were studied with the multiplane tomographic scanner. This device detected all lesions visualized with other instruments. When compared to the scintillation camera, the tomoscanner provided additional information in 12% of the cases. When compared to the other scanners, the percentage was somewhat higher. In liver and kidney scanning, its advantage was sharper resolution of all space-occupying lesions. This resulted in the detection of lesions missed by the scintillation camera in 13 of 77 cases. In brain scanning, it allowed more accurate localization of focal lesions by reference to the normal cross-sectional anatomy of the brain. In lung and pancreas scanning, the superior resolution did not result in the detection of any additional lesions. (auth)

24258 REDUCTION OF PHYSIOLOGIC DEGRADATION IN IMAGING THE LIVER. Smoak, William M.; Smith, Edward M.; Kenny, Peter J. (Univ. of Miami, Miami Beach, Fla.). J. Nucl. Med.; 12: 119-22(Mar 1971).

Physiologic motion degradation of liver imaging was reduced by placing the patient in a prone position and by visualizing the patient by an under-the-table detector. A more realistic liver image was obtained because the margins were sharpened and the peripheral noise was reduced. In addition to decreased motion perturbation in the prone position, the liver parenchyma was more likely to fall within the focal volume of the collimator when the patient was in the prone or lateral decubitus positions and was viewed by an under-the-table detector. As a rule commercial single-probe detectors cannot be inverted to take advantage of this position. The upper detector of a dual-detector system reduced imaging time, but yielded a degraded image of the liver. Flexible detector devices with parallel-hole collimators such as the Anger camera and the Autofluoroscope may be used under the table. For an optimal tomographic device for liver imaging, the detector must view the liver from beneath the imaging plane. (auth)

24259 TOMOGRAPHIC IMAGING WITH THE SCINTILLATION CAMERA IN THE DETECTION AND CHARACTERIZATION OF BRAIN LESIONS. Chamroenngan, Suthichalerm; Langan, James K.; Tratter, James M.; Muehllehner, G.; Wagner, Henry N. Jr. (Johns Hopkins Medical Institutions, Baltimore). Radiology; 98: 445-8(Feb 1971).

In a preliminary evaluation of 50 patients suspected of having neurological disease, tomography contributed significantly to the diagnosis, location, and delineation of mass lesions of the brain. Further evaluation of tomography is in progress. (auth)

24260 BASAL-CELL CARCINOMA OF HEAD AND NECK. RADIOLOGIC EVALUATION AND VALUE OF ANGIOGRAPHY. Firooznia, H.; Kricheff, I. I.; Young, R.; Naidech, H. (New York Univ., N. Y.). N. Y. State J. Med.; 71: 429-32(15 Feb 1971).

Five hundred thirty-four cases of basal-cell tumor of the head

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and neck were reviewed. Forty-three patients or 8% had long-standing, invasive, and recurrent lesions, with invasion of the underlying soft tissues and bones. Three representative patients in whom angiography of the carotid artery was performed are presented. The radiologic findings of invasive basal-cell tumors are described. Most of these patients had lytic lesions. However, a small number demonstrated blastic or mixed lesions. Strontium-85 photoscanning is recommended in all patients suspected of having bone involvement whose x-ray films reveal negative findings. It is believed that angiography of the carotid artery should be included as a routine procedure in the total medical and surgical evaluation of these patients for a more accurate delineation of the extent of the lesion, as a guide for radical treatment, and for the diagnosis of the neurologic manifestations of the intracranial extension of the tumor that may otherwise be attributed to other causes. (auth)

24261 FALSE POSITIVES AND NEGATIVES WITH ^{87m}Sr. Galasko, C. S. B. (Radcliffe Infirmary, Oxford); Charkes, N. David. J. Nucl. Med.; 12: 142-3 (Mar 1971).

Eight patients with radiological apparent skeletal metastases were examined with the Anger gamma camera following intravenous administration of ^{87m}Sr. During the first 30 to 45 min very little ^{87m}Sr was localized in the skeleton and false positives were noted. As the radionuclide cleared from the circulation, the false positives were no longer found. Some metastases were not found in four of eight patients. Comparison with ^{18}F in these patients showed that ^{18}F scintigrams were more accurate. (E.E.H.)

24262 THYROID NODULE SCANS MADE WITH PERTECHNATE AND IODINE MAY GIVE INCONSISTENT RESULTS. Usher, Michael S.; Arzoumanian, Artin Y. (Jewish General Hospital, Montreal). J. Nucl. Med.; 12: 136-7 (Mar 1971).

A case is presented of a patient with trabecular adenoma which trapped $^{99m}TcO_4^-$ but did not hold ^{131}I for 24 hr. It was concluded that the two techniques do not always give equivalent results. (auth)

24263 VISUALIZATION OF HUMAN ADRENAL GLANDS IN VIVO BY SCINTILLATION SCANNING. Beierwaltes, William H.; Lieberman, Lionel M.; Ansari, Azizullah N.; Nishiyama, Hiroshi (Univ. of Michigan, Ann Arbor). J. Amer. Med. Ass.; 216: 275-7 (12 Apr 1971).

The adrenal glands of a patient with Cushing's syndrome were visualized repeatedly with a rectilinear photoscanner and an Anger camera following the administration of a dose of ^{131}I-19-iodocholesterol. Both adrenal glands appeared to concentrate ^{131}I-19-iodocholesterol equally and were similar in size. This supported the clinical impression that the steroid excess in this patient was caused by bilateral adrenocortical hyperplasia rather than by a functioning unilateral adrenocortical tumor. (auth)

24264 DIAGNOSTIC IMPORTANCE OF INFUSION UROGRAPHY AND ISOTOPE NEPHOGRAMS IN CHRONIC KIDNEY INSUFFICIENCY. Dieterich, W.-R.; Guenther, H.; Strangfeld, D.; Gerstberger, S. (Humboldt-Univ., Berlin). Deut. Gesundheitsw.; 25: 2139-44(5 Nov 1970). (In German).

In 55 patients suffering from chronic renal insufficiency of different genesis infusion urograms were made putting the evaluatability into correlation to the serum creatinine level. With creatinine values below 5 mg% in the serum most summation radiographs already yielded diagnostic information. With higher creatinine values zonographs were required, apart from few exceptions. The value of serum creatinine constitutes the most reliable parameter for the indication for infusion urography. Infusion urography was performed at creatinine values above 1.5 mg%. Even with values up to 20 mg% evaluatable measuring results were obtained. No detrimental effects of infusion urography upon the renal function were observed. The isotope nephrogram is superior to infusion urography with regard to the separate functional diagnostics (separate for each side) at renal insufficiencies of a lower degree (serum creatinine below 5 mg%). With a serum creatinine above 5 mg% the diagnostic information furnished by the isotope nephrogram becomes unreliable. With values above 10 mg% the isotope nephrogram cannot yield any results evaluatable in differential diagnostic respect, whereas the demonstration of the kidneys and of the lower urinary channels may be successful by means of infusion urography. (auth)

24265 CHOROID PLEXUS PAPILLOMAS. OBSERVATIONS ON RADIOGRAPHIC DIAGNOSIS. Rovit, Richard L.; Schechter, Mannie M.; Chodroff, Paul (St. Vincent's Hospital and Medical Center, New York. New York Univ., N. Y. Albert Einstein Coll. of Medicine, New York). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 110: 608-17 (Nov 1970).

A review is made of 234 cases of choroid plexus papillomas collected from the literature, to which 11 unpublished personal cases are added. The clinical features, plain roentgenographic findings of the skull, and the value of pneumography, cerebral angiography, and gamma encephalography in establishing the diagnosis are discussed in detail. The majority of choroid plexus papillomas occurred within the first decade of life and were invariably associated with hydrocephalus. Suture separation, craniofacial disproportion, increased digital markings, and other roentgenographic changes of increased intracranial pressure provide no specific proof as to the nature of location or the underlying pathology. (auth)

24266 DIAGNOSTIC VALUE OF ^{131}I-EXCRETION AND FORTY-EIGHT HOUR ACTIVITY OF THE THYROID. Konrady, A.; Katona, A.; Policzer, M. Radiol. Diagn.; 11: 255-63(1970). (In German).

It is possible to obtain data on hormonal incretion of the thyroid by the examination of ^{131}I-excretion and 48 hr plasma activity. The diagnostical value of both function-tests was analyzed and their parallel or different decrease in 100 patients, in each either an increased ^{131}I-secretion or an increased 48 hr plasma activity was present. The 48 hr plasma activity was increased in this material mostly in the case of hyperthyroidism with simultaneous increase of ^{131}I-secretion. In the other cases the specimens yielded discordant results. Contributing factors are given and the completion of examination in the interest of the clarification of other disturbances by ^{131}I-secretion is recommended. According to these examinations the assay of ^{131}I-secretion contrary to the measurement of 48 hr plasma activity for the judgement of the hormonal secretion of the thyroid seems to be more reliable. (auth)

24267 DETERMINATION OF SPLEEN MASS FROM RADIONUCLIDE IMAGES. Rollo, F. D.; DeLand, F. H. (Johns Hopkins Medical Institutions, Baltimore). Radiology; 97: 583-7 (Dec 1970).

A method of estimating spleen mass from the posterior and left lateral views of the radionuclide photoscans is described. When only the posterior view is available, a modification of this technique can be used. The methods are independent of configuration, require few measurements, and involve only one equation. The results are reproducible and correlate well with values determined at postmortem examination. (auth)

24268 RENAL SCINTIGRAPHY IN PYELONEPHRITIS. Davies, E. Rhys; Roberts, J. B. Michael; Heney, N. M.; Stadden, G. (United Bristol Hospitals, Eng. Southmead Hospital, Eng.). Proc. Roy. Soc. Med.; 64: 63-4(Jan 1971).

Renal scintigraphy is a valuable additional method of investigating renal abnormalities in chronic pyelonephritis because it is a unique way of detecting early renal cortical damage before the renal architecture is distorted. Seventy-nine patients with a clinical diagnosis of chronic pyelonephritis were investigated. Scintigraphy was done 2 hr after intravenous injection of 100 mCi of ^{197}Hg-labeled chloromerodrin. (P.B.M.)

24269 EVALUATION OF ROENTGEN EXPOSURE IN MAMMOGRAPHY. PART II. FOUR VIEWS. Gilbertson, James D.; Randall, Mitchell G.; Fingerhut, Aaron G. (Los Angeles County Harbor General Hospital, Torrance, Calif.). Radiology; 97: 641-7(Dec 1970).

Radiation exposure was measured in 100 female patients undergoing mammography by the Egan technique. Both axillary views were excluded to simulate expected exposures in a large population survey. Additionally, 40 phantom studies were performed on a modified Alderson-RANDO phantom. Every attempt was made to reproduce the clinical situation. Patient dose ranged from background on the dorsum of the left foot to a maximum of 11 R on the surface of the inner breast. This compares to a maximum of 18 R reported earlier when the axillary views were included. With axillary views omitted, bone marrow measurements showed a 300% reduction in exposure. (auth)

24270 SOCIETY OF NUCLEAR MEDICINE, INDIA, FIRST ANNUAL CONFERENCE, BOMBAY, 22–23 DECEMBER, 1969. Programme and Abstracts. Trombay, India; Bhabha Atomic Research Center ([1970]). 35p. (CONF-691226-(Absts.)).

Abstracts of 24 papers presented at the conference are included. Some topics discussed were: ^{131}I uptake in thyroid disorders; autoradiography of thyroid lesions; renal scanning using ^{131}I-labeled hippuran and ^{203}Hg-labeled neohydrin; role of scintiscanning in kidney disease; use of ^{90}Y for hypophysectomy; studies on the life span of red blood cells using ^{51}Cr; role of digital computers in nuclear medicine; and synthesis of radioisotope-labeled hormones. (H.L.W.)

Radiotherapy

Refer also to abstracts 23920, 24053, 24119, 24166, 24167, 24169–24172, 24189, 24303, 24357, 24399, 24431, 24436, 24441, 24442, 24445, 24448, 25549, 25550, 25591, and 25592.

24271 (LA-4602) PROCEEDINGS OF THE BIOMEDICAL SESSIONS OF THE FOURTH LAMPF USERS MEETING HELD AT THE LOS ALAMOS SCIENTIFIC LABORATORY, LOS ALAMOS, NEW MEXICO, OCTOBER 30-31, 1970. Groce, David E.; Harper, Katherine H. (Los Alamos Scientific Lab., N. Mex.). Feb 1971. Contract W-7405-eng-36. 57p. (CONF-701043). Dep. NTIS.

Design features of the biomedical facility for meson beam therapy are described. It is anticipated that construction will begin during 1971. Data previously published on radiobiological factors relevant to the use of pi meson beams for the radiotherapy of neoplasms are reviewed. It is pointed out that the data are based on results obtained using cultured cells. The principal therapeutic advantages associated with pi mesons discussed include the reduced oxygen enhancement ratio (OER) at the Bragg peak, the favorable differences in depth dose vs surface dose, and the reduced possibility of sublethal damage in deep-seated tumors. The possibility of using negative mu mesons for determinations of the elemental composition of tissues for diagnostic studies is also discussed. (C.H.)

24272 (UCRL-Trans-1422) USE OF THE EXISTING CHARGED HEAVY-PARTICLE ACCELERATORS AND THE POSSIBILITIES OF CREATING NEW DOMESTIC ONES FOR RADIATION THERAPY. Dzhelepov, V. P.; Gol'din, L. L. (Joint Inst. for Nuclear Research, Dubna (USSR)). Translated by Maria Kassatkin (Univ. of California, Lawrence Radiation Lab., Berkeley, from report JINR-P9-4560. 36p. (CONF-690448-1). Dep. NTIS.

From Symposium on Problems in the Development of Radiation Therapy Techniques in Oncology, Moscow, USSR.

Therapy of malignant tumors by means of heavy particles of high energies is a progressive principle in medicine promising success. The accelerated development of ion-corpuscular therapy and its use with electron-photon therapy is an urgent problem. Existing proton accelerators opened a front for clinical and research work and indicated the construction of a series of special medical accelerators and the necessary equipment for a number of oncological institutes is not connected with any serious technological difficulties and requires no excessive capital expenditures. (auth)

24273 (UCSF-10-P-2-123) NEW APPROACHES TO THE OXYGEN PROBLEM IN RADIOTHERAPY: ULTRA-HIGH DOSE RATE AND RADIOPROTECTIVE COMPOUNDS. Phillips, Theodore L.; Kane, Lawrence L. (California Univ., San Francisco. Lab. of Radiobiology). [1969]. 10p. (CONF-700645-1). Dep. NTIS.

From Conference on newer techniques and technology in radiotherapy and onocology; Los Angeles, Calif. (5 Jun 1970).

Two new approaches to the oxygen problem in radiotherapy are reported. The results with ultra-high dose rate irradiation suggest that a decrease in the oxygen effect can be obtained with ultra-high dose rates by means of oxygen depletion. Because this depletion appears to occur at total doses that are quite high (probably over 1500 or 2000 rads in vivo), however, it has little clinical promise. Results with new thiophosphate radioprotective compounds are more promising. (auth)

24274 EVALUATION OF GAMMA RAY DOSE IN THE RECTUM DURING TREATMENT OF CARCINOMA OF THE UTERINE CERVIX WITH RADIUM. Nozdryn-Plotnicki, Boguslaw; Lukawska, Krystyna (Instytutu Onkologii, Warsaw). Nowotwory; 20: 107-13(Apr-Jun 1970). (In Polish).

The main purpose of this investigation was to establish the maximum gamma dose in the rectum during treatment of uterine cervix carcinoma with radium. Dose measurements in the rectum of 109 patients treated by radium during 1963-1964 were performed. Using Siemens Gammameter the dose in the rectum was determined in each patient before and after correction of the position of the intravaginal and intrauterine aplicators. It was found that the gamma dose in the rectum during treatment in the vagina depends on the type of applicator and anatomical conditions and varies from 800 to 6,500 R. The average dose range was from 2,900 to 3,700 R. The average point of maximum dose is 8-9 cm from the anus. The gamma dose in the rectum from an intrauterine tube varies from 500 to 5,900 R and depends on the length of the tube. The average dose varies from 1,300 to 3,700 R. The average point of maximum dose is 9 to 11 cm from the anus. The analysis showed that difference in the average doses to the rectum before and after correction of the position of applicators is greater during treatment in the uterus than in the vagina. There was also greater variation in average doses during treatment in the uterus than in the vagina. Rectal injuries appeared in 4 of 109 patients observed during 3 years (4%). In two the dose in the rectal wall was very high, one of these patients died of rectal injuries. (auth)

24275 STATE OF ORGANS AND SYSTEMS FOLLOWING RADIOTHERAPY OF CANCER OF THE THYROID GLAND. Ivanitskaya, V. I.; Makhonina, M. S.; Shutilova, A. A.; (and others). (Kharkov Scientific Research Inst. of Medical Radiology). Med. Radiol.; 15: No. 4, 27-32(Apr 1970). (In Russian).

The combined use of external and internal irradiation for therapy of malignant thyroid glands did not cause gross organic disturbances in the function of the cardiovascular and nervous systems, liver, or kidneys either immediately or at a remote period following treatment. Greater changes occurred in these systems in patients with hypothyroidism. Radioinduced histological changes, leukopenia and lymphopenia, were encountered more frequently at remote periods following therapy. These changes were dose dependent, and were stable in only 27.2% of the patients. Local atrophication and fibroid changes in the skin of patients was dependent upon dose and occurred more frequently as a result of repeated teletherapy. The use of ^{131}I in the combined treatment method for thyroid cancer patients substantially improved the latent results of teletherapy, and did not cause gross organic changes or disturbances in the functions of the organs and systems studied. (tr-auth)

24276 RADIOTHERAPY OF CANCER OF THE OESOPHAGUS. Vitale, V.; Ricci, G. (Galliera Hospital, Genoa). Minerva Radiol.; 15: 86-97(Mar 1970). (In Italian).

A comparison was made between the radiotherapy of esophageal cancer employed in the Galliera Hospital and the methods described in the literature. A brief reference is made to the different radiological and surgical indications for such treatment and is followed by the presentation of a personal series. Emphasis was placed on the need for planned treatment as soon as the diagnosis has been made. Therapy cycles should be interspersed with brief rest periods to enable an assessment of the evolution of the site to be made. (auth)

24277 PHYSICAL ASPECTS AND CLINICAL ESTIMATION OF THE MODIFIED PARIS METHOD OF UTERINE CERVIX CANCER TREATMENT BY MEANS OF RADIUM. Domaradzka-Wozniak, Anna (Akademy of Medicine, Danzig). Acta Biol. Med. (Gdansk); 14: 7-52(1969). (In German).

The physical analysis and clinical estimation of the modified Paris method of uterine cervix cancer treatment by means of radium are given. The modification was based on using radium sources of greater active length in vaginal applications. The physical estimation is presented on the basis of data obtained from experimental measurements of dose distribution of radium used in gynecological applications. Isodose curves are given for types of vaginal and uterine applicators used, enabling the evaluation of the absorbed doses in the important points of the pelvis and their comparison with doses obtained in the method generally in use. The results of the treatment that took into account the post-irradiation injuries of neighboring organs were established after checking the fate of 285 patients treated by this method and remaining under medical control for more than five years. (auth)

24278 11th ANNUAL MEETING OF THE AMERICAN SOCIETY FOR HEAD AND NECK SURGERY, NEW ORLEANS, MARCH 1969. Arch. Otolaryngol.; 91: 501-51(Jun 1970). (CONF-690349).

Separate abstracts were prepared for two papers presented at the conference. An additional nine papers were presented on various aspects of head and neck surgery. (H.L.W.)

For abstracts of individual papers see: 24279 and 24428.

24279 CANCER AT THE ANTERIOR COMMISSURE OF THE LARYNX. RESULTS WITH RADIOTHERAPY. Kirchner, John A. (Yale Univ., New Haven). Arch. Otolaryngol.; 91: 524-5(Jun 1970).

From 11th Annual Meeting of the American Society for Head and Neck Surgery, New Orleans, La. See CONF-690349.

Radiotherapy is not the treatment of choice for glottic cancer which crosses from one vocal cord to the other at the anterior commissure. The anatomy of this area creates difficulty in diagnosis and in follow-up observation, in addition to predisposing the area to undertreatment or to radionecrosis. (auth)

24280 ELECTRON BEAMS. Laughlin, John S. (Sloan-Kettering Inst. for Cancer Research, New York). pp 91-149 of Radiation Dosimetry. Vol. III. /Attix, Frank H. (ed.). New York; Academic Press Inc. (1969).

A review of the production, measurement, and use of electron beams for medical purposes is given. The various accelerators (van de Graaff generators, field-emission machines, linear accelerators, dynamitrons, betatrons, and synchrotrons) and beam-control techniques (flattening, scanning, collimation, and focusing) available are sketched. Electron energy calibration by magnetic deflection, nuclear reactions, range measurement, and scintillation pulse-height analysis is discussed. Dose measurement may be by calorimetry, chemical reaction, ionization chamber, photographic film, or thermoluminescence. The electron-beam intensity

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may be monitored by Faraday cups, ionization chambers, or other means. Several pertinent electron-beam parameters are derived theoretically—these include the local absorbed dose as related to cavity-chamber ionization; the three-dimensional spatial distribution of dose in extended tissue-equivalent media; the electron flux density, current, and charge distribution; and electron energy and angular distributions. The features of electron therapy that are attractive for medical application are enumerated. The spatial dose distribution and dose specification are considered. The article concludes with a discussion of treatment-planning. (171 references) (R.W.R.)

24281 HEAVY CHARGED-PARTICLE BEAMS. Raju, Mudundi R. (Univ. of California, Berkeley); Lyman, John T.; Brustad, Tor; Tobias, Cornelius A. pp 151-99 of Radiation Dosimetry. Vol. III. /Attix, Frank H. (ed.). New York; Academic Press Inc. (1969).

After a general introduction to the effects of heavy charged particles on tissues, results are given for the energy loss, range-energy relation, and multiple scattering of heavy charged-particle beams. Various detectors of heavy charged particles are described, including the ionization chamber, Faraday cup, secondary-emission monitor, activation dosimeter, and semiconductor detector. The techniques for measurement of heavy charged-particle beams are treated, including the Bragg ionization curve, beam profiles and isodose contours, integral-range curves, energy-loss measurement, and energy measurements; special considerations for dose measurements with semiconductor detectors are included. Various techniques for determining and controlling the exposure are discussed; these include the track-average and track-segment methods, the use of ridge filters, and the production of discrete lesions through the use of collimated beams. (126 references) (R.W.R.)

24282 PHYSIKALISCHE UND TECHNISCHE GRUNDLAGEN DER BESTRAHLUNGSPLANUNG. (Physical and Technological Principles of Irradiation Schemes). Matschke, S.; Richter, J.; Welker, K. Leipzig; VEB Georg Thieme (1968). 362p. 74.90 Mark.

Radiation planning in radiotherapy is discussed especially from the standpoint of the physicist, engineer, and clinical radiologist. Chapters on the interaction between ionizing radiation and material, energy absorption and transfer, principles of dosimetry, effects on depth dose, various radiation techniques, determination of dose distribution, fixation of radiation fields, and recording of radiation data are included. (H.B.G.)

24283 USE OF BENZYDAMINE HYDROCHLORIDE (TANTUM) OR BENZYDAMINE HYDROCHLORIDE WITH TETRACYCLINE (TANTUM BIOTIC) IN RADIOTHERAPY. Cascelli, G. Nunt. Radiol.; 35: 161-79(Feb 1969). (In Italian).

Discussion is presented on about 50 patients with neck and oral carcinomas (tongue, larynx, parotid gland, thyroid, cheek, pharynx, nasal fossae, and lateral lymph nodes of the neck) and 23 patients with bladder carcinoma, nearly all of whom were treated by supervoltage cobalt therapy as well as by simultaneous administration of benzydamine hydrochloride (Tantum) or benzydamine hydrochloride with tetracycline (Tantum Biotic) as a preventive or curative ancillary therapy. Both above mentioned drugs were found to be effective in partially or totally soothing the patient's pain, thereby allowing radiotherapy to be completed more easily. The efficacity of such drugs appears to be enhanced when above-mentioned therapy is carried out as a preventive means, at the beginning of radiotherapy. (auth)

24284 LUCHEVAYA TERAPIYA ELOKACHESTVENNYKH OPUKHOLEI MOCHEVOGO PUZYRYA. (Radiotherapy of Malignant Tumors of the Urinary Bladder). Pereslegin, I. A.; Sarkisyan, Yu. Kh. Moscow; Izdatel'stvo Meditsina (1969). 216p.

A discussion of the radiotherapy of malignant tumors of the urinary bladder is presented. Preceding a discussion of the clinical aspects, a brief discussion of primary epithelial malignant tumors of the bladder is given. Following a discussion of indications and contraindications for radiotherapy, the preparations for irradiation of the patient are given stressing the value of localizing the tumor by transverse scanning, production of isodose field maps at the level of the tumor, focusing the radiation beam during telegammatherapy, and the effects of patient size on the isodose field. Methods for radiotherapy of urinary bladder tumors and fundamentals of dosimetry are discussed. Methods and dose calculations for static and rotating telegammatherapy with lead grids and wedge-shaped lead filters are revealed using tables and illustrations. Methods and dose calculations are also given for internal irradiation of these tumors using solutions of ^{198}Au, ^{24}Na, ^{60}Co, and also radioactive beads of ^{60}Co and macroaggregates of ^{60}Co. Additional studies were conducted to determine the extent of protection and safety for medical personnel during the therapeutic application of radioisotopes. The book is intended for surgeons, urologists, oncologists, radiologists, and technical personnel in radiotherapy. (tr-auth)

24285 MEDICAL APPLICATION OF FAST NEUTRONS. 1. Watanabe, Noritoshi (Tokyo Univ.). Hoshasen Kagaku; 13: 274-9(Apr 1970). (In Japanese).

Physical characteristics of fast neutrons are reviewed and applications of fast neutrons in the treatment of malignant tumors are described. Biological reaction of fast neutrons with mammalian tissues is due to charged particles emitted by the reaction between fast neutrons and the atomic nucleus of hydrogen, carbon, oxygen, and nitrogen normally present in the tissue. Physical characteristics of fast neutron interactions include: emission of γ rays formed by interactions with hydrogen atoms, emission of recoil protons that account for 90 to 70% of the absorbed dose, and emission of low-energy protons formed by the reaction of the neutron with nitrogen in the tissue. Initial fast neutron therapy revealed that it produced a grave later damage in the skin and subcutaneous tissue. Animal experiments with swine indicated that fractionated dose irradiation resulted in greater relative biological effectiveness. Skin damage in the early therapy was thought to be due to the divided irradiation of 5 to 15 minutes from a 60-inch cyclotron for a period of 3 to 9 weeks. Radiation sensitivity is proportional to the amount of oxygen. The majority of tumors of over 10 mm in diameter contain anoxic cells and the supply of external oxygen becomes insufficient. Fast neutrons with high linear energy transfer have low oxygen enhancement ratio and are suited for the treatment of malignant tumors because the effect is not dependent on the presence or absence of oxygen. (Japan)

24286 MEDICAL APPLICATION OF FAST NEUTRONS. 2. Watanabe, Noritoshi (Tokyo Univ.). Hoshasen Kagaku; 13: 285-91(May 1970). (In Japanese).

The effectiveness of radiotherapy of neoplasms using fast neutrons is discussed in comparison with that using x rays. Dose distribution in the diseased foci after irradiation with 6 MeV fast neutrons and 8 MeV x rays comes to 82% and 93%, respectively. The dose producing biological effects on anoxic cells is related to the depth dose ratio and oxygen enhancement ratio (o.e.r.) and is 1.7 for 6 MeV fast neutrons and 3.1 for 8 MeV x rays. This, together with relevant data on mean focal dose, indicates that fast neutrons give the same effect as x rays in normal tissue cells and are effective in killing anoxic cells. Applications of fast neutrons in radiotherapy clinics, where divided dose irradiation is the principal schedule, make it difficult to know whether the same number of anoxic cells would be present at every irradiation, and it becomes necessary to examine how much useful gain can be expected from the dose distribution. There is no significant difference between fast neutrons and x rays in their effect on recovery and repair, but there is less chance of intracellular recovery within 24 hours or repair for sub-lethal damage after fast neutron irradiation. There are still a number of problems to be solved before applications of fast neutrons are practical for clinics in Japan. (Japan)

24287 SUPERVOLTAGE RADIATION THERAPY OF THE STOMACH CARCINOMA. 1. THE SIDE REACTIONS AND THE COMPLICATIONS OF MASSIVE TUMOR DOSE IRRADIATION. Asakawa, Hiroshi; Watabe, Nobuyuki (Miyagi Prefectural Adult Disease Center, Natori, Japan). Nippon Igaku Hoshasen Gakkai Zasshi 29: 1304-12(Jan 1970). (In Japanese).

A total of 31 patients with carcinoma of the stomach received massive tumor doses of radiation using two parallel opposing portals using 6 MeV x rays generated from a linear accelerator. Preoperative irradiation in the dose of 5000 rads was delivered to the patients with early carcinoma and also to some with advanced carcinomas, and 7000 to 10,000 rads was delivered to most of the advanced patients for curative irradiation and to those who were given palliative preoperation or postoperative irradiation. Two schedules of dose fractionation were used; a simple fractionation schedule of 200 rads given 5 days a week, and an intermittent massive dose schedule of 500 rads delivered twice a week. Radiation sickness was not so severe as to interrupt continuation of the therapy, but radiation gastritis was observed in many patients when the tumor dose was over 4000 rads that induced symptoms similar to those of radiation sickness. Other complications include anorexia, loss of body weight (more than 2 Kg), decrease of serum proteins (more than 0.5 g/dl) and leukopenia observed in about half of the patients. No change was observed in serum electrolyte and enzymes or in liver functions. Massive gastric bleeding occurred in two cases and one of them was found to have penetration of the stomach. These findings confirm the indications for massive dose radiation therapy for stomach carcinomas. (Japan)

24288 RADIOTHERAPY OF MALIGNANT LYMPHOMAS, WITH SPECIAL REFERENCE TO SYSTEMATIC IRRADIATION. Miyazaki, Yasuichi (Hiroshima Univ.). Hiroshima Igaku; 23: 120-6(Jan 1970). (In Japanese).

The spread of malignant tumors was examined by lymphangiography in 48 cases of malignant lymphoma patients having the primary focus in the head and neck region and who had received radiotherapy by ^{60}Co γ therapy. Systematic large-field irradiation was carried out to evaluate the cure rate achieved. In the past, irradiation of the primary focus alone was made and the disease soon changed to stage three that, even in early cases, resulted in death. Local recurrence was apt to occur when irradiation was limited to below 1250 R, and recurrence in the surrounding area occurred in a small irradiated field. Based on these observations, a dose of 2500 to 3500 R over a large field was given during 2 to 3 weeks. Even if the tumor nodule disappeared following irradiation, recurrence and metastasis were inevitable and irradiation did not seem to be effective for cure. Systematic irradiation on stage three cases was proved to give good prognosis. Systematic prophylactic irradiation was possible using 15 MgR and this dose of irradiation was found to be safe, based on various test results. In systematic irradiation, volume dose increased to 30 to 40 MgR and tended to produce other symptoms. (Japan)

24289 RANDOMIZED STUDY OF HYPERBARIC OXYGEN AS AN ADJUNCT TO REGULARLY FRACTIONATED RADIATION THERAPY FOR CLINICAL TREATMENT OF ADVANCED NEOPLASTIC DISEASE. Tobin, D. A.; Vermund, H. (Univ. of Wisconsin, Madison). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 111: 613-21(Mar 1971).

In order to more comprehensively evaluate the potential of the oxygen effect in patients with advanced neoplastic disease of the head and neck, cervix, bladder, rectum, esophagus and brain, a randomized series was designed to test the efficacy of hyperbaric oxygen as an adjunct to x radiation therapy as compared to radiation therapy alone. One-half of the patients admitted to this study of the theoretic potentials of hyperbaric oxygen received 100 per cent oxygen under 3 atmospheres absolute pressure as an adjunct to regularly fractionated daily radiation therapy. The other half received daily radiation therapy alone. Data are presented on 52 patients. There were no significant differences in survival noted in any of the anatomic areas of advanced neoplasms in the randomized series of daily radiation therapy with hyperbaric oxygen as an adjunct compared to the radiation therapy alone series. (C.H.)

24290 STATISTICAL AND CLINICAL EVALUATION OF THE RADIOTHERAPY OF CARCINOMA OF THE MOTILE TONGUE BETWEEN 1947 AND 1964 (318 CASES). Banfi, A.; Milani, F.; Pozzoli, P. (Univ., Milan. Istituto Nazionale per lo Studio e la Cura dei Tumori, Milan). Radiol. Med.; 56: 499-511(Jun 1970). (In Italian).

A group of 318 patients suffering from carcinoma of the motile tongue were treated by radiotherapy. Radium-226, in the form of needles, was used for interstitial γ therapy in 260 patients, with doses usually between one and two mCi/cm^2 delivered over a five to eight day period, while 58 patients received external ^{60}Co γ beam therapy. The overall survival rate was 43% at three years and 36% at five years. (C.H.)

24291 CONSIDERATION OF THE TREATMENT OF MALIGNANT TUMORS OF THE OVARIES (ON THE BASIS OF 104 STUDIES). Clement, R.; Almaric, R.; Spitalier, J. M.; Ayme, Y.; Robert, F. J. Radiol., Electrol., Med. Nucl.; 50: 235-9 (Mar-Apr 1969). (In French).

A review is presented of studies on the treatment of 104 cases of ovarian cancer. The patients were of all ages, although the majority were between the ages of 40 and 70 years. A classification of cases according to location and type of tumor is outlined. Three courses of treatment were administered, as follows: surgery followed by post-operative radiotherapy; radiotherapy (telecobalt and telecesium) following laparotomy in inoperable cases; and chemotherapy using cyclophosphamide, chlorambucil, and thiotepa. Results of treatments are described and evaluated. Tables are presented to show survival of all cases and different types of cases; effect of mode of treatment on survival; effect of type of radiation and dose on survival; and influence of age on survival. It was concluded that a combination of surgery and radiotherapy gave the best results. The most effective radiotherapy was high-energy cobalt applied externally. The palliative value of chemotherapy is discussed and the importance of hormone therapy for maintaining the level of estrogens is pointed out. (H.L.W.)

24292 IMPORTANCE OF BUILD-UP THICKNESS IN THE DOSE INCREASE PRODUCED ADJACENT TO VOIDS IN TISSUE-EQUIVALENT MATERIAL EXPOSED TO 10 TO 35 MeV ELECTRONS. Starchman, Dale E.; Chao, Jen-hung (IIT Research Inst., Chicago. Mercy Hospital, Chicago). Radiology; 98: 435-7 (Feb 1971).

The increase in dose adjacent to voids was systematically measured as a function of void diameter for combinations of incident electron energy and void thickness, utilizing build-up layer thicknesses of $\frac{1}{4}$, $\frac{1}{2}$, and 1 in. Plots of percentage void dose vs void diameter are given. Marked changes in dose were observed when the build-up layer thickness was varied. (auth)

24293 PERCUTANEOUS ^{198}Au GRAIN IMPLANTATION METHOD AND COMPUTERIZED DOSIMETRY IN THE TREATMENT OF HEAD AND NECK TUMORS. Son, Yung H.; Wakley, Jack (Brooklyn-Cumberland Medical Center, N. Y. State Univ. of New York, Brooklyn. Univ. of Virginia, Charlottesville). Radiology; 98: 425-9(Feb 1971).

A new permanent implantation method using ^{198}Au seeds and a guiding template for head and neck tumors is reported. The percutaneous or transoral approach provides unlimited accessibility to any location in the head and neck regions. Although further experience and longer observations are necessary, the cure rate of early lesions may be improved by this technique with minimum morbidity. (auth)

24294 ADVISABILITY OF TREATING ALL FIELDS AT EACH RADIOTHERAPY SESSION. Wilson, Charles S.; Hall, Eric J. (Columbia Univ., New York). Contract AT(30-1)-2740. Radiology; 98: 419-24(Feb 1971).

The significance of treating all fields or only one prescribed field at each radiotherapy session was evaluated using the concept of nominal standard dose as well as data from a mammalian cell survival curve. Analysis with either system demonstrated greater homogeneity of biological effect within the treatment volume when all prescribed fields were administered at each treatment session. The importance of this effect varied with the clinical situation. (auth)

24295 TIME-DOSE RELATIONSHIPS IN RADIATION THERAPY OF LYMPHOSARCOMA AND GIANT FOLLICLE LYMPHOMA. Seydel, H. Gunter; Bloedorn, Fernando G.; Wizenberg, Morris; Berk, Sanders (Univ. of Maryland, Baltimore). Radiology; 98: 411-18(Feb 1971).

Radiotherapy as primary treatment for lymphosarcoma and giant follicle lymphoma in 62 patients was evaluated for the rate of recurrence in treated areas as the first manifestation of relapse. For lymphosarcoma, local recurrence was prevented by use of ^{60}Co γ or x radiation with 3,500 rads tumor dose or more in four weeks. Giant follicle lymphoma did not recur after radiotherapy with more than 2,000 rads tumor dose in 10 to 21 days. The five-yr survival of lymphosarcoma patients was higher when treated with the higher radiation dose. (auth)

24296 SUPERSELECTIVE ARTERIAL CATHETERIZATION AS A VEHICLE FOR DELIVERING RADIOACTIVE INFARCT PARTICLES TO TUMORS. Lang, Erich K. (Louisiana State Univ., Shreveport). Radiology; 98: 391-9(Feb 1971).

Arterial infarct implantation to tumors is suggested as a logical extension of selective arterial perfusion of tumors with chemotherapeutic agents. The arterial bed of a tumor provides an arborized system which allows the distribution of infarct particles to various areas of the tumor, while the propensity of arteries to respond to infarction by means of spasm, as well as the resulting preferential flow to other areas, facilitates a geometric distribution of infarct sources. Experience in the treatment of 20 patients with hypernephroma and 12 patients with advanced pelvic neoplasms is described. (auth)

24297 PARATHORMONE AND ^{32}P THERAPY IN PROSTATIC CANCER WITH BONE METASTASES. Tong, Eddy C. K. (Brooklyn-Cumberland Medical Center, N. Y. Bellevue Hospital, New York). Radiology; 98: 343-51(Feb 1971).

Eight patients with intractable bone pain and/or rapid deterioration from widely disseminated prostatic carcinoma unresponsive to orchiectomy and estrogen therapy were treated with parathormone followed by radiophosphorus. The parathormone was used to create, upon its withdrawal, a rebound force that led to an increase of deposition of radiophosphorus in bone and its tumors. The results were dramatic. All patients had complete relief of severe pain as well as overall improvement. There was reduction of the serum acid and alkaline phosphatase and evidence of bone healing as demonstrated in the roentgenograms. (auth)

24298 TECHNIQUE FOR IMAGING PATIENT TREATMENT AREA DURING A THERAPEUTIC RADIATION EXPOSURE. Haus, A. G.; Pinsky, S. M.; Marks, J. E. (Univ. of Chicago. Argonne Cancer Research Hospital, Chicago). Radiology; 97: 653-6(Dec 1970).

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The ^{60}Co and Van de Graaff supervoltage therapy machines were used to investigate a film technique for imaging throughout a complete patient treatment. The technique offers quality control in treatment verification and increased efficiency. The maximum patient exit dose ranged from 80 to 160 rads. Internal anatomy and shielding in the treatment are advantageously imaged at a relatively high dose during the actual irradiation. Sensitometric curves of the films exposed to ^{60}Co are shown. Utilization of a Maltese cross setup on a patient with Hodgkin's disease is discussed with check and complete treatment films. (auth)

Radiation Effects on Animals

Refer also to abstracts 23938, 24041, and 24207.

24299 (JPRS-52402) SPACE BIOLOGY AND MEDICINE, VOL. 4, NO. 6, 1970. Translation of Kosm. Biol. Med.; 4: No. 6, 3-87(1970). 126p. NTIS.

Nineteen articles are included; separate abstracts were prepared for three. The remaining 16 articles contain general information on real or simulated space flights not in scope for NSA. (E.E.H.)

For abstracts of individual papers see: 24153, 24338, and 24339.

24300 BLASTOGENIC FACTOR IN UNIDIRECTIONAL MIXED CULTURES WITH X-IRRADIATED CELLS. Kasakura, Shinpei (Royal Victoria Hospital, Montreal). Transplantation; 11: 117-21 (Feb 1971).

Cell-free medium (CFM) from cultures of unmixed or mixed irradiated human leukocytes stimulated ^{3}H-thymidine uptake by fresh allogeneic leukocytes. At least some component of the blastogenic factor was antigenically specific. The blastogenic factor from cultures of irradiated leukocyte mixtures was much more active than that from cultures of unmixed irradiated leukocytes. The activity of the blastogenic factor was affected by the dose of irradiation and the time interval between the end of irradiation and the preparation of cultures. The blastogenic factor from mixed cultures of irradiated and intact cells was consistently less stimulatory to fresh leukocytes from the donor of the irradiated cells in the original mixture (source of CFM) than it was to fresh leukocytes from the original donor of the intact cells. These data raise the possibility that production of a blastogenic factor may be involved in the stimulation of responding lymphocytes in mixed cultures. (auth)

24301 IN VITRO IRRADIATION OF EMBRYONIC HAMSTER FIBROBLASTS WITH ULTRAVIOLET LIGHT OF 280 nm. Buder, E.; Rahn, I.; Schramm, T.; Wetzel, R. (Deutsche Akademie der Wissenschaften, Berlin). Arch. Geschwulstforsch; 36: 335-8 (1970). (In German).

Cell cultures prepared from embryonic hamster tissue have been irradiated 5 to 10 times by uv light of wavelength 280 nm and doses of 1.0×10^4 erg/cm^2. After cultivation time of 40 days 1×10^6 to 5×10^6 cells, harvested mechanically, were inoculated subcutaneously into newborn Syrian hamsters. During cultivation in vitro and after transplantation of these irradiated cells into animals, no signs of malignant transformation could be observed. So these irradiation experiments in vitro with uv light of wavelength 280 nm gave negative results just as in our former experiments with 254 nm. (auth)

24302 MECHANISM OF CELL RESISTANCE AGAINST RADIATION DAMAGE AND ITS SIGNIFICANCE. Suzuki, K. (National Inst. of Radiological Sciences, Chiba, Japan). Hoshasen Kagaku; 12: 165-8(Nov 1969). (In Japanese).

A review is presented of studies on the changes that occur in animal cells following irradiation, and the role of DNA in repair and resistance mechanism. Physical and chemical changes induced in DNA according to the quality and dose of radiation, and their influence on biochemical mechanism of DNA are discussed. These changes are not necessarily in proportion to the amount of damage received by DNA, and is related to the recovery ability due to protective mechanism, such as the repair of damaged DNA. Cells which lack this recovery mechanism or which failed to undergo recovery, still have the ability to resist radiation, as was revealed by recent studies, and indicate a relationship between genetic recombination mechanism and mechanism of resistance against radiation. When the NaCl concentration of the medium is increased after irradiation of a microorganism, its resistance is markedly increased. A mutant strain, whose DNA synthesis is inhibited at high temperature, showed progress in synthesis at high temperature in the presence of a high concentration of NaCl, and this suggests the important role of cytoplasmic membrane in radiation resistance. Considering its correlation with the problem of recovery, changes in DNA would effect replication error from m-RNA to proteins and would probably be related to the aging phenomenon. If life and death of an organism were to be held by the balance of error and its repair, radiation may be understood as affecting such a relation. (Japan)

24303 EXTRA-CORPOREAL IRRADIATION OF THE BLOOD OF CALVES. Schnappauf, Hp. (Univ., Ulm, Ger.). Zentralbl. Veterinaermed., Beih.; No. 11, 16-20(1970). (In German).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

Blood from the carotid artery was passed continuously through a source of radiation and then returned to the jugular vein of the animal. During its passage through the radiation source it was subjected to a transit dose which was lethal for lymphocytes but had little effect on erythrocytes. In this way the host can be starved of lymphocytes without being subjected to irradiation. This technique, which was developed originally in calves, is used therapeutically in human medicine. (auth)

24304 LEUCOCYTIC REACTION IN THE DOMESTIC FOWL (GALLUS DOMESTICUS) AFTER VARIOUS X-RAY EXPOSURE RATES. Prochazka, Zdenek (Veterinary Research Inst., Brno). Zentralbl. Veterinaermed., Beih.; No. 11, 21-4(1970).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

The reaction of the white blood-cell picture in a group of adult domestic fowl, Gallus domesticus, irradiated with x rays within the range 12.5 to 2000 R, was studied. The comparison between the depth of leucopenia on the 3rd to the 9th day and the extent of regeneration of leukocytes on the 28th day following irradiation with the applied doses showed that both indicators are dependent on the exposure rate. Only the lowest exposures were without depressive effect (12.5 and 25 R), while complete regeneration was accomplished still at the 100-R exposure. All higher exposure rates manifested themselves in a negative manner in both indicators; the formerly established rate of LD_{50} was found to be the limit in the leukopenic response below which the organism is not able to react to a further diminution of the number of leukocytes. In the extent of reconvalescence, LD_{50} was also found to be the limit of break after which it dropped again to altogether negative values. (auth)

24305 THYMUS GLAND. A HEMATOPOIETIC ORGAN. V. THE EFFECT OF SYNGENEIC PHYTOHEMAGGLUTININ INCUBATED LYMPHOCYTES ON THE SURVIVAL TIME OF MICE, IRRADIATED WITH A LETHAL BONE MARROW DOSIS. Schneiberg, K.; Jonecko, A.; Szymaniec, S.; (and others) (Institut fuer Immunologie und Experimentelle Therapie, Wroclaw. Instutut fuer Onkologie, Gliwice, Poland). Folia Haematol. (Leipzig); 93: 1-15(1970). (In German).

An in vitro preincubation with PHA was shown for mouse thymocytes and lymph node cells to be effective in revealing their therapeutic activity, when injected to lethally irradiated syngenetic recipients. A dosis of 2.7 to 6.4×10^5 living, activated cells after intravenous injection enables 7% of recipients to survive more than 50 days, and brings about a remarkable prolongation of survival in 25% of such animals. The same pre-treatment abolished the therapeutic effect of xenogenetic lymphocytes. Thus, the hypothesis seems to be reinforced about the virtual need of adequate functional stimulation for a lymphocyte, before its overtaking the function of a true myeloid stem-cell. This stimulation equals that leading to a lymphoblastoidal pathway of transformation. With thymocytes of young mice and with lymph node cells of older mice especially good therapeutic results were obtained. Thymectomized recipients did not survive longer than 84 days after irradiation and a distinct lymphopoietic insufficiency was observed in them. In contrast, intact recipients survive more than 9 months. With age of an animal, its thymus seems to transfer hemopoietic-precursor-potentialities into cells of peripheral lymphoid organs. However, the important function of thymus as central lymphatic organ remains lifelong in regulating lymphopoiesis and the mutual relationship lymphopoiesis: myelopoiesis as well. (auth)

24306 FORMATION OF POLYNUCLEAR AND GIANT CELLS OF A HeLa CULTURE UNDER THE INFLUENCE OF COMBINED ADMINISTRATION OF 5-FLUOROURACIL AND IRRADIATION. Mirzo'ev, E. A. (Inst. for Advanced Training of Physicians, Moscow). Azerb. Med. Zh.; 47: No. 7, 22-6(Jul 1970). (In Russian).

HeLa cells were irradiated using a linear electron accelerator (dose, 155 rad), alone and in combination with administration of 5-fluorouracil (with doses of 0.5, 2, 40, and 80 γ/ml). Observations were made for a period of 7 days after treatment. The densest formation of polynuclear and giant cells was observed at the higher

radiation doses (500 and 250 rad). With low doses of 100 and 50 rad, no significant formation of polynuclear and giant cells was observed for 3 days after initiation of the irradiation treatment. When 5-fluorouracil (0.5 γ/ml) was administered and irradiation was continued for 1.5 hour, however, a great number of polynuclear and giant cells were formed after 3 days. The dose dependence of these phenomena was studied in detail and statistically analyzed. A quantitative relationship was found between the formation of polynuclear and giant cells and both the radiation dose and various doses of 5-fluorouracil. The cells formed behaved like gradually dying elements. (JPRS)

24307 RELATIONSHIP BETWEEN THE DOSE OF RADIATION AND THE NUMBER OF DOUBLE BREAKS IN THE DNA OF THE LS/BL LYMPHOSARCOMA CELLS. Juraskova, V.; Drasil, V. (Inst. of Biophysics, Brno). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 109-14(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

LS/Bl lymphosarcoma cells were cultivated in the peritoneal cavity of mice and their DNA was labeled with ^{3}H. X irradiation was then carried out with doses of 100 to 800 rad. The method of centrifugation was used to determine the number of single or double breaks in DNA by estimation of the molecular weight. It was found that the DNA of cells of the LS/Bl lymphosarcoma is very sensitive to the formation of double breaks after irradiation in vivo. (F.M.M.)

24308 COMPARISON OF THE EFFECT OF ACRIDINE DERIVATIVES AND SIMILAR SUBSTANCES ON THE DIMERIZATION OF THYMINE IN MAMMALIAN DNA IN SITU AND ISOLATED. Klimek, M.; Sevcikova, P. (Inst. of Biophysics, Brno). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 115-22(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

DNA of mouse LS/Bl lymphosarcoma cells was uv irradiated either in situ or after isolation. The effects of acridine orange, proflavine, methyl green, acriflavine, methylene blue, and riboflavine on dimerization of thymine in irradiated DNA were investigated. It was found that acridine dyes and methyl green in sufficiently high concentrations led to a marked decrease of thymine dimerization in isolated irradiated DNA but not in DNA irradiated in situ. (F.M.M.)

Invertebrates

Refer also to abstracts 24120 and 24121.

24309 EFFECT OF ACUTE GAMMA IRRADIATION ON THE BRINE SHRIMP, ARTEMIA. I. LIFE SPANS AND MALE REPRODUCTIVE PERFORMANCE. Squire, Richard D.; Grosch, Daniel S. (North Carolina State Univ., Raleigh). Biol. Bull.; 139: 363-74(Oct 1970).

Freshly matured male and female specimens of Californian Artemia (stock No. 3) were irradiated with acute doses of 0, 0.1, 1, 2, 5, 10, or 100 kR γ radiation and pair-mated to untreated animals. Significant reductions in life span resulted after 50 or 100 kR to either sex. Reductions in female life span approached significance after 10 kR. Treated males were completely sterile after doses of 50 to 100 kR. Males that received doses of 5 or 10 kR had an initial fertility period lasting 12 days, followed by permanent sterility. After a dose of 2 kR, seven out of a sample of eight males demonstrated the same initial period of fertility, followed by a period of sterility. Two of the seven subsequently recovered their fertility. No sterile period occurred after 0.1 or 1 kR. Hatchability data failed to detect induced dominant lethality in sperm (and perhaps spermatids) after 2 kR. Induced damage resulted in 73% dominant lethal events at 10 kR. No effects on other stages were observed at less than 2 kR. (F.M.M.)

24310 PATHOPHYSIOLOGY OF INFECTIONS WITH NORMAL AND IRRADIATED METACERCARIAE OF FASCIOLA HEPATICA. Movsesijan, M. (Inst. for the Application of Nuclear Energy in Agriculture, Veterinary Medicine, and Forestry, Zemun, Yugoslavia); MacLean, J. M.; Sokolic, A. Brit. Vet. J.; 125: 564-7(Nov 1969).

Experiments are described on the loss from the circulation and fecal excretion of ^{51}Cr in rabbits 8 weeks after infection with normal or irradiated metacercariae of Fasciola hepatica, and in control non-infected rabbits. The potential use of isotopically labeled red cells and plasma proteins for measuring the degree of radiation-attenuation in F. hepatica studies is discussed. (auth)

24311 CHANGES IN THE UV SENSITIVITY IN THE EMBRYOGENESIS OF DROSOPHILA. Levin, V. L. (Inst. of Cytology, Leningrad). Tsitologiya; 13: 212-20(Feb 1971). (In Russian).

Eggs obtained from synchronous 5 min batches of the normal line were irradiated ages from 20 min (zygote), 60 min (cleavage), 90, 12 and 150 min (nuclei attaining the surface of the egg, formation and development of syncytial preblastoderm resp.), 180 min (blastoderm), and 420 min (the onset of embryo segmentation). The results are presented as dose effect curves calculated from the percent of egg lethality and fly hatching. In addition, the frequency of morphoses was taken into account. Embryos of syncytial preblastodermal stage proved to be most sensitive to uv radiation. At the blastoderm stage and later on the embryo uv sensitivity decreases, although the nuclei still remain at the egg surface. A low reparatory capacity of the embryo in the period of syncytial preblastoderm is supposed. (auth)

24312 DETERMINING RESPONSE OF INSECTS TO RADIATION BY CONTINUOUS MONITORING OF THEIR CARBON DIOXIDE OUTPUT. Turner, W. K.; Charity, L. F. (Iowa State Univ., Ames). Ann. Entomol. Soc. Amer.; 64: 419-24 (Mar 1971).

A respiration monitoring technique, utilizing an infrared (ir) carbon dioxide analyzer, was developed for measuring insect response to periodic stimuli and was used to determine relative responses of the adult European corn borer, Ostrinia nubilalis (Lepidoptera: Pyraustidae), to bands of ultraviolet (uv), visible and ir radiation, with wavelengths ranging from 0.313 to 15 μ. Carbon dioxide production of the insects was continuously monitored as they were subjected to a single, narrow band of uv or visible radiation or a wide band of ir radiation for 5 minutes every 30 minutes, over a 20-hour period. The technique successfully detected physical responses to the radiation stimuli. Response data were recorded automatically with a data acquisition system and processed by computer. Strongest responses were obtained for the near uv and shorter wavelength visible bands. Responses were weak for bands in the orange region but were, surprisingly, moderately strong in the red region. No responses were obtained for the ir radiation bands. (auth)

24313 POPULATION RESPONSE OF TWELVE SPECIES OF INSECTS FOLLOWING EXPOSURE TO IONIZING RADIATION. Cherry, Donald S.; Willard, William K. (Clemson Univ., S. C.). Ann. Entomol. Soc. Amer.; 64: 456-61(Mar 1971).

Samples of insects representing 10 genera in 2 orders, Lepidoptera and Orthoptera, were exposed to 15,000 rad of gamma radiation from a Cobalt-60 source. The population response of these species was then studied using life tables as an evaluative aid. Mean life expectancy of the 0–1 age class of specimens of 6 species of irradiated Lepidoptera decreased 7–33% from that of the control, depending on the species. However, life expectancies of 6 Orthoptera were reduced by about 90%, in most cases, following radiation exposure. Treated moth populations of all age groups had lowered life expectancies as well as a reduction in the number of age classes. Periplaneta americana (L.) was the most radiosensitive orthopteran studied and Cadra cautella (Walker) the most sensitive lepidopteran. Supella longipalpa (F.) was the most resistant orthopteran species studied and Plodia interpunctella (Hübner) the most resistant lepidopteran. Age-specific mortality rates of treated populations increased with age at a faster rate than did mortality rates of control groups in the species studied. (auth)

24314 PLASMODIUM CYNOMOLGI: X-IRRADIATION AND DEVELOPMENT OF EXO-ERYTHROCYTIC SCHIZONTS IN MACACA MULATTA. Warren, McWilson (National Inst. of Allergy and Infectious Diseases, Bethesda, Md.); Garnham, P. C. C. Exp. Parasitol.; 28: 551-6(Dec 1970).

Sporozoites of Plasmodium cynomolgi cynomolgi and the langur strain of P. cynomolgi were exposed to various dosages of x-irradiation while still in the salivary glands of living Anopheles atroparvus. The impact of this irradiation on the development of exo-erythrocytic stages in the liver of Macaca mulatta receiving the sporozoites was studied. Ten-krad doses apparently inactivated all sporozoites while lesser doses produced graded responses as reflected in morphologic changes in developing exo-erythrocytic schizonts. Five krad doses allowed the development of exo-erythrocytic schizonts generally normal in appearance and with only slightly reduced mean dimensions. In all of the sublethal radiation dosages used, reduced size and the appearance of a limiting membrane were the most prominent changes noted. Small but apparently normal schizonts as well as grossly modified forms were sometimes seen in the same biopsy. Some monkeys receiving irradiated sporozoites showed reduced parasitemias over those seen in controls. (auth)

24315 HISTOMONAS MELEAGRIDIS: EFFECT OF GAMMA RADIATION ON IN VITRO GROWTH. Ruff, M. D.; Hansen, M. F. (Kansas State Univ., Manhattan). Contract AT(11-1)-1209. Exp. Parasitol.; 28: 450-64(Dec 1970).

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Histomonas meleagridis in DeVolt's alkaline serum medium were exposed to various dosages of gamma rays. No immediate effect of the radiation was observed. The LD_{50} for the organism grown 28–54 days in vitro was 400 kR, and the LD_{50} after 209 days of growth was 80 kR, demonstrating a definite age effect on radiosensitivity. In the experiments, an exposure of 50 kR did not influence the growth of Histomonas, when compared with the controls. Intermediate dosages (150 and 200 kR) reduced growth. A relationship was found between an extended lag phase and the level of exposure. In some irradiated groups there was an extension of the number of days during which logarithmic growth occurred. An exposure of 100 kR stimulated growth, but apparently the stimulation range was narrow; for example, exposures of 75 and 125 kR retarded growth, compared with the controls. Growth changes were transmitted to subsequent generations. Data from the subculture of exposed cultures indicated that more organisms were produced in the 100 and 150 kR groups than in the control group. Growth in the 200 kR group was comparable with that in the control group. Organisms in the 150 and 200 kR groups decreased significantly in size by 7 days after radiation. Adding nonirradiated cecal bacteria to nutrient medium increased survival of irradiated histomonads. These treated cultures could survive more than 400 kR, and many of the effects of exposure also were eliminated. DeVolt's medium was exposed to 0, 50, 100, 200, and 300 kR to determine whether irradiated media affected growth. No effect was observed with exposure to 50 kR. Growth was retarded by exposures of 100 and 200 kR and greatly retarded by 300 kR. Histomonas grown for 7 days in the medium exposed to 300 kR were significantly larger than those in the control group. (auth)

24316 VLIYANIE IONIZIRUYUSHCHIKH IZLUCHENII NA NASEKOMYKH. (Effects of Ionizing Radiations on Insects). Kalmykov, P. G. Mowcow; Atomizdat (1970). 144p.

The biological actions of ionizing radiations on insects are discussed. An analysis is presented of the biophysical, biochemical, morphological, physiological, and genetic bases for the effects of radiations on insects. The mechanisms of radioresistance in insects, in comparison with other organisms in the animal kingdom, are indicated. The possibility of using ionizing radiations for the extermination of insects is discussed. The book is designed for a wide range of readers interested in entomology, including technicians, post graduate students, practicing entomologists, and students of biology. (tr-auth)

24317 INFLUENCE OF AGE AND RADIATION DOSE-RATE ON SOME EFFECTS OF GAMMA RADIATION ON TWO STORED-PRODUCT PESTS. Brown, Gary Allen. Athens, Ga.; Univ. of Georgia (1970). 93p. University Microfilms Order No. 71-3716.

Thesis.

The influence of radiation dose-rate and age of specimens on some effects of gamma radiation on the eggs of the grain mite, Acarus siro, and the red flour beetle, Tribolium castaneum, were studied. Eggs of A. siro were irradiated with 3 krad of gamma radiation from a Cobalt-60 source at dose-rates of 6, 18, and 43 rad/second. They were irradiated at five ages. Significant variations in the numbers of eggs hatching and the hatching time resulted from treating eggs at different ages. Eggs irradiated at 3 days were the most sensitive and had the longest mean hatch time and the lowest total hatch. The influence of dose-rate on the number of A. siro eggs hatching was of very small magnitude. There were also negligible differences in the hatching times for eggs irradiated at the three different dose-rates. Eggs of T. castaneum were irradiated at three ages with 2.5 krad of gamma radiation at dose-rates of 6, 18, and 43 rad/second. There were significant variations in the hatching time due to age and significant differences in total hatch due to age and dose-rate. Irradiated 2-day old eggs were the most sensitive, having the longest mean hatch time and the lowest total hatch. Eggs irradiated at 43 rad/second had significantly fewer eggs hatching than those irradiated at 6 and 18 rad/second. (Diss. Abstr. Int., B)

24318 CHANGE OF RADIOSENSITIVITY AND OF CONTENT OF SH GROUPS IN EARLY EMBRYOGENESIS OF THE LOACH (MISGURNUS FOSSILIS). Smirnova, I. B.; Latsis, R. V. (Inst. of Developmental Biology, Moscow). Dokl. Akad. Nauk SSSR; 192: 915-16(1970). (In Russian).

Fish eggs were subjected to an x ray dose of 1000 R. Beginning from the moment of appearance of the first sign of division (60 to 70 min after fertilization), the eggs were sampled each 5 min. One portion of the eggs was subjected to irradiation, and another portion was fixed for histochemical treatment. The number of surviving embryos was counted 24 hr after fertilization. The content of protein SH groups was also determined by a cytophotometric method on slices of the eggs. It was found that egg survival was low when the SH content was low (at 60 to 70, 105 to 110, and 135 to 145 min after fertilization). Conversely a high embryo survival was associated with a high level of thiols. A linear relationship was found between the percent survivals and the content of protein SH groups (log of the transmission). Thus it can be assumed that cyclic changes in radiosensitivity in early embryogenesis are associated with cyclic changes in the content of protein SH compounds. (TTT)

Vertebrates

Refer also to abstracts 23946, 23955, 23958, 23959, 23965, 23984–23987, 23989, 23997, 23998, 24012, 24039, 24047, 24054, 24055, 24059, 24060, 24065, 24067, 24068, 24087, 24100, 24125, 24147, 24203, 24204, 24206, 24209, 24215–24223, 24225, and 24462.

24319 (AEC-tr-7195, pp 275-85) BIOLOGICAL EFFECT OF SMALL DOSES OF ^{90}Sr ON THE BODY OF DOGS. Burykina, L. N.; Klimova, E. N.; L'vitsina, G. M. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

A study was conducted on dogs to determine the biological effects of small ^{90}Sr concentrations exceeding the maximum permissible concentration in water by a factor of two. Sixteen dogs were given doses of 2.10 μC of ^{90}Sr/kg wt for 31 months. The results showed that no substantial functional changes in the bodies of the dogs took place over the entire period of observation. A relative study of the radiosensitivity of different systems of the body of dogs made it possible to conclude that transitory functional shifts in conditioned reflex activity, indexes of natural immunity, and deviation in metabolism of sex hormones related to earlier reactions of the body to the chronic effect of ^{90}Sr. (E.E.H.)

24320 (AEC-tr-7195, pp 309-13) CHANGE IN THE ELECTRICAL CONDUCTIVITY LEVEL OF TISSUES AS A STRUCTURAL AND FUNCTIONAL INDEX OF THE CHRONIC ACTION OF ^{90}Sr. Berezovskaya, G. E. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

The impedance of surviving tissues of liver, blood, muscles, and bone marrow of rats following daily doses of ^{90}Sr in various quantities was measured. These tissues were studied in the first and second litters of three different dose groups. Up to 1 month of age, i.e., before delivery of young from the females, the dose difference between litters of corresponding groups was provided by the ^{90}Sr obtained during intrauterine development and from maternal milk after birth. The results led to the conclusion that the nature of a change in the impedance at different frequencies as reflected in frequency changes in capacitance was different for different organs, and was associated with morphological and molecular structural features of the tissues. Dose differences in the change in capacitance were evident in the change in its absolute values as compared with the control and these changes have a phase character with a tendency toward a linear dependence only with an increase in the dose. The nature of frequency changes in the capacitance under thermal lesion of the liver resembled the changes observed in the bone marrow of the highest dose group and revealed a disturbance in the polarization structure under the influence of incorporated ^{90}Sr. (E.E.H.)

24321 (AEC-tr-7195, pp 314-29) BIOLOGICAL ACTION OF ^{233}Pa. Zalikin, G. A. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

Experiments were conducted on 280 female white rats to determine the biological action of protactinium-233 following intravenous administration. Data on the life spans of rats given varying doses showed that rats die from the same dose of ^{233}Pa in both the acute and in the subacute and chronic phases of radiation sickness. LD_{50} was calculated for different periods following administration of ^{233}Pa. Acute illness was characterized by the development of leukopenia and anemia of the hyperchromic type, a symptom complex of hemorrhagic diathesis, degenerative changes in the parenchymatous organs, stoppage of growth, and a drop in the weight of the rats. With the development of leukopenia, changes were noted in lymphopoiesis such as a drop in the number of lymphocytes. The lymphocyte profile of the blood was retained over the entire period of acute radiation illness. Even during restoration of leukopoiesis, neutrophil leukocytosis was not noted. A depression of the nervous system expressed as a lengthening of the reflex time and an increase in the excitability threshold was observed. Higher doses of ^{233}Pa resulted in the dose absorbed in the tissues reaching the skeleton. Values of the absorbed doses in the spleen, liver, and kidneys were three times less than in the skeleton. (E.E.H.)

24322 (AEC-tr-7195, pp 330-8) MORPHOLOGICAL CHANGES IN THE INTERNAL ORGANS OF RATS UNDER THE ADMINISTRATION OF ^{233}Pa. Kazbekova, D. A.; Zalikin, G. A. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

Parallel toxicological and pathomorphological investigations were made on the effects of ^{233}Pa in rats. Data are presented on the action of ^{233}Pa on internal organs in doses causing acute and subacute forms of radiation sickness. Ninety-six female rats were given intravenous injections of a citrate solution of ^{233}Pa. It was found that the isotope caused considerable damage to the parenchymatous organs, especially the excretory organs. Changes in the kidneys in the acute stage of radiation sickness were characterized by degenerative necrotic disorders in the epithelial cells of the convoluted tubules. In the subacute and chronic stages in the lungs, connective tissue elements increased, especially along the arterioles and in the manubria of the glomeruli. Protactinium-233 also had a considerable effect on the vascular system and permanent impairments in blood formation occurred. (E.E.H.)

24323 (AEC-tr-7195, pp 339-46) ON THE ROLE OF THE TIME FACTOR IN SEPARATE AND COMBINED INJECTION WITH ^{144}Ce AND ^{239}Pu. Buldakov, L. A.; Kalmykova, Z. I.; Moskalev, Yu. I.; Strel'tsova, V. N. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

The effects of α and β emitters on the life span, cellular composition of the peripheral blood, and the frequency of osteoma were investigated. Rats were given a hydrochloric solution of ^{144}Ce and/or a citric acid solution of ^{239}Pu intraperitoneally in doses that totaled one to two times the optimal osteosarcomogenous dose. The results showed that under all types of administration the life span of the rats was considerably lowered. The frequency of the development of osteoma depended on the order and rhythm of administration of the isotopes. The results of the study of shifts in the cellular composition of the peripheral blood confirmed the significance of the reactive background of the body for repeated administrations of α and β emitters. (E.E.H.)

24324 (AEC-tr-7195, pp 347-53) ON THE STATE OF THE BLOOD SYSTEM IN RATS UNDER INHALATION AFFECTION BY ^{239}Pu. Kudasheva, N. P. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

Data on the study of the morphological composition of the blood and bone marrow under single and chronic inhalation of plutonium-239 are presented. Rats were subjected to the inhalation of aerosols of plutonium citrate and a complex salt of plutonium ammonium pentacarbonate. Tests were conducted after single inhalation, during chronic inhalation, and after final administration. Single inhalation of 0.024 μCi/lung or chronic (160 days) inhalation with a daily deposition of 0.02 μCi/lung produced no changes in the blood system. After a single inhalation of 0.64 μCi/lung there was a tendency towards a reduction of the total number of leukocytes at the terminal stage. During chronic inhalation of 0.004 μCi/lung for 60 days, a moderate depression of erythropoiesis, leukopoiesis, and lymphopoiesis occurred. Restoration of the number of leukocytes in the peripheral blood was noted in the bone marrow during depressed leukopoiesis. (E.E.H.)

24325 (AEC-tr-7195, pp 354-63) ON CERTAIN CHANGES IN THE RED BLOOD AND HEMODYNAMICS UNDER THE INHALATION INJURY OF RATS BY A CITRATE OF ^{239}Pu. Kalmykova, Z. I. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

A study was undertaken to determine the changes in the cytometry and resistance of erythrocytes, the mass of the circulating blood, oxygen saturation of the blood, and the rate of blood flow in rats under single and chronic inhalation of ^{239}Pu citrate. On the first day after single inhalation of 0.648 μCi, macrospherocytosis of erythrocytes, a shift in the erythrogram to the left, a drop in the saturation of arterial blood with oxygen, a sharp increase in the mass of circulating blood, and an acceleration of maturation of reticulocytes were noted. In subsequent periods, normalization of blood oxygen occurred, the rate of blood flow and maturation of reticulocytes slowed down, and macrospherocytosis of erythrocytes was replaced by normo- and microplanocytosis. Under a single inhalation of ^{239}Pu with a concentration of 0.106 μCi in the lungs, these changes were ameliorated. During chronic inhalation for 160 days with a daily deposition of 0.004 μCi in the lungs, macrocytosis with spherocytosis was noted on the 40th day. Macro- and planocytosis were observed immediately after final dosage and at the end of the experiment the dimensions of the erythrocytes were normal. The erythrogram shifted to the left during macrospherocytosis and coincided with the control in the period of micro- and normocytosis. (E.E.H.)

24326 (AEC-tr-7195, pp 388-96) ON THE PROBLEM OF THE TOXICITY OF ^{106}Ru UNDER REPEATED INTRATRACHEAL ADMINISTRATION TO RATS. Burykina, L. N. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

Studies were made on the toxic effects of ^{106}Ru on the blood and lungs of rats following intratracheal administration of ^{106}Ru totaling 0.4 μCi/g over a period of six months. Results showed that 75 days after administration of Ru, 10% of the total quantity remained in the lungs. The multiple action of the isotope caused a reduction in growth and a rise in the mortality of the experimental rats. A study of hematogenesis function showed a drop in the level of lymphocytes and the development of neutrophil leukocytosis, especially during the terminal stage. Histology of the lungs showed necrotic changes and the development of chronic inflammatory reactions, intensification of proliferative processes, hyperplasia and metaplasia of the epithelium of the bronchi with signs of an atypical nature, and the appearance of bronchiogenic cancer in three rats. (E.E.H.)

24327 (AEC-tr-7195, pp 405-12) EFFECT OF ^{90}Sr ON PROGENY. Burykina, L. N.; Lyaginskaya, A. M. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

The effects of ^{90}Sr on the progeny of dogs subjected to the extended action of its ionizing radiation were studied. Male and female dogs were given 0.02 μCi/kg per day for 3 to 3½ yrs in the diet. An absorbed dose in the skeleton of the parents of up to 50 rad/yr led to a disturbance in the development and lowered viability of their progeny. The data indicated disturbances developed in the offspring of late litters born after final administration of ^{90}Sr to parents with chronic radiation sickness. The highest mortality was observed in the newborn and 2 to 3 month old puppies. In subsequent periods, the direct causes of death were infections and general dystrophy and dyspepsia. (E.E.H.)

24328 (AEC-tr-7195, pp 422-32) EFFECT OF A SINGLE ADMINISTRATION OF TRITIUM OXIDE ON THE STATE OF TESTES AND THE VIABILITY OF PROGENY OF RATS. Lyaginskaya, A. M. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

Studies were made on the morphological changes in the testes of adult male rats following injection of tritium oxide and functional changes in the male sex glands and these effects on the development of their progeny. Results showed that there was a high degree of sensitivity of the germinal epithelium of the testes to all doses but the restoration of spermatogonia production depended on the magnitude of the dose. Gradual and irreversible changes in the testes and suppression of spermatogenesis were observed with complete sterility between six and 12 months. A dose of tritium oxide of 0.08 produced temporary suppression of spermatogenesis and only partial sterility in the rats. A rise in the number of dominant lethals in the spermatozoa with all dosages led to the death of offspring in the antenatal and postnatal periods. The frequency of the rise of dominant lethals was directly related to the level of the administered dose. (E.E.H.)

24329 (AEC-tr-7195, pp 433-8) FEATURES OF THE DEVELOPMENT OF EMBRYOS OF RATS UNDER INJECTION WITH TRITIUM OXIDE AT DIFFERENT STAGES OF ANTENATAL LIFE. Lyaginskaya, A. M. Translated from Radioaktivnye Izotopy i Organizm, Izdatel'stvo Meditsina, Moscow, 1969.

From Radioactive isotopes and the body.

Some of the data obtained on the effects of tritium oxide on the development of rats in the course of the entire period of embryogeny are presented. The experimental study involved 109 sexually mature female and 30 male rats. The females were given 0.3 μCi of tritium oxide during various stages of pregnancy. The degree of injury and intrauterine mortality of the embryos was large and depended on the length of the pregnancy at the time of administration. Tritium oxide also caused irreversible changes in the fetal sacks and placentas in the rats. (E.E.H.)

24330 (BRH/DBE-70-7) RADIATION BIO-EFFECTS, Summary Report, January–December 1970. Hodge, Donald M. (comp. and ed.) (Bureau of Radiological Health, Rockville, Md.). 267p.

Activities of the Division of Biological Effects during 1970 are summarized. The investigations of Epidemiologic Studies Branch

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and the Experimental Studies Branch which comprise the Division are discussed. Titles of papers that division investigators have prepared for presentation and those appearing in print during the year are listed. (auth)

24331 (COO-119-242, pp 94-121) DYNAMICS OF LIFE. I. DEATH FROM AGING, CANCER, IRRADIATION, POISONS, AND OTHER STRESSES. Stover, Betsy J.; Eyring, Henry (Utah Univ., Salt Lake City. Radiobiology Div.).

From Research in Radiobiology.

The occurrence of a mutation reflects a change in the environment of a cell which may be an alteration in the concentration of a critical precursor to the gene. Since biological processes proceed near equilibrium, the occurrence of such a change results in counter changes. Thus the mutation rate is a steady state phenomenon. Application of the theory of absolute reaction rates makes it possible to analyze the life shortening and oncogenic action of irradiation. Death curves for non-irradiated beagles that die from aging and cancer and those for beagles that receive skeletal alpha irradiation leading to osteogenic sarcomata are similar in shape. They differ in that death occurs earlier in the case of the irradiated dogs, and the hastening of death is a function of the radiation dose. (auth)

24332 (COO-119-242, pp 122-30) DYNAMICS OF LIFE. IVa. LENTICULAR CATARACTS INDUCED OF AGING AND IRRADIATION. Stover, Betsy J. (Utah Univ., Salt Lake City. Radiobiology Div.).

From Research in Radiobiology.

The recently developed steady state theory of mutation rates was used to compare the effects of aging and irradiation on the lens of the eye. A set of data for rats, which included animals irradiated by x rays or neutrons and non-irradiated animals, was used. It was found that functional survival of the organ could be analyzed separately from survival of the animal. Results indicate that at high doses of radiation two cataractogenic mechanisms are operative, an early acting independent mechanism and an acceleration of the aging mechanism. At lower doses the latter mechanism is dominant. (auth)

24333 (COO-119-242, pp 211-42) RADIATION INDUCED INTRAOCULAR MELANOMAS. Taylor, G. N.; Lloyd, R. D.; Atherton, D. R.; Mays, C. W.; Shabestari, L.; Williams, J. (Utah Univ., Salt Lake City. Radiobiology Div.).

From Research in Radiobiology.

Prolonged retention of ^{226}Ra, ^{228}Ra, or ^{228}Th results in a significant number of intraocular melanomas in beagles. Thus far, such tumors occurred below the lowest presently observed osteosarcoma dose by factors of 3 and 6 for ^{226}Ra and ^{228}Ra, respectively. They have developed at the lowest osteosarcoma dose in ^{228}Th dogs, but not below this level. Intraocular melanosis was induced by ^{90}Sr and ^{239}Pu but, thus far, intraocular neoplasms were not produced by these radionuclides. (auth)

24334 (COO-119-242, pp 243-57) RADIUM INDUCED SUBCELLULAR TAPETAL CHANGES. Taylor, G. N.; Anderson, N.; Voigtlaender, K.; Angus, W. (Utah Univ., Salt Lake City. Radiobiology Div.).

From Research in Radiobiology.

The cells of the canine tapetum lucidum were characterized by densely packed, elongated rod-like structures which were the principal sites of radium retention in the tapetum. Radiation induced changes following a single intravenous injection of ^{226}Ra or ^{228}Ra were clearly seen in these rod-shaped organelles. The lesions were dose dependent and occurred down to relatively low dose levels. Such changes were probably related, at least in part, to the rate of radium removal from this part of the eye. (auth)

24335 (COO-119-242, pp 354-62) PRELIMINARY REPORT ON HEMATOLOGICAL EFFECTS OF ^{241}Am IN THE BEAGLE. Dougherty, Jean H. (Utah Univ., Salt Lake City. Radiobiology Div.).

From Research in Radiobiology.

The hematological changes following intravenous injection of a wide range of doses (from 0.0018 to 2.8 μCi/kg) of ^{241}Am into young adult beagles were reported for 18 months post-injection. There is a dose dependent depression of white cells at the four highest dose levels (2.8, 0.9, 0.3, 0.1 μCi/kg injected activity) which for granular leukocytes and monocytes is maximal by one month after injection. Lymphocytes decrease more slowly with minimal values observed about one year or later. Depression of red cells is seen only after injection of 0.9 and 2.8 μCi/kg. The hematological response in general is similar to that seen after injection of comparable amounts of ^{239}Pu. (auth)

24336 (COO-119-242, pp 385-401) BONE CANCER INDUCTION BY RADIONUCLIDES: INCIDENCE VS. DOSE. Mays, Charles W.; Dougherty, Thomas F.; Taylor, Glenn N.; Stover, Betsy J.; Jee, Webster S. S.; Christensen, William R.; Dougherty, Jean H.; Stevens, Walter Jr.; Nabors, Charles J. Jr. (Utah Univ., Salt Lake City. Radiobiology Div.).

From Research in Radiobiology.

Dose-response relationships are reveiwed for several bone seeking radionuclides in dogs, rodents, and humans. This includes beagles injected with ^{239}Pu, ^{228}Th, ^{226}Ra (MsTh), ^{226}Ra, or ^{90}Sr; rats injected with ^{90}Sr; mice injected with ^{90}Sr or ^{226}Ra; dial painters and other humans containing ^{226}Ra and ^{228}Ra (MsTh) and patients injected with ^{224}Ra (Th-X). For the β-emitter ^{90}Sr, a sigmoid dose response relationship is seen, characterized by a low risk region in which few if any bone cancers were induced. This suggests that considerable recovery from β-irradiation is possible, provided that the dose rate is sufficiently low. For the α emitters, data on ^{226}Ra in humans support a practical threshold, below which few if any cancers should be induced; while data on ^{226}Ra in mice support a linear relationship in which cancer induction increases in direct proportion to dose, provided that the dose is not excessive. The other α emitter results, each considered separately, can rule out neither the linear nor the threshold models although taken collectively, the threshold model seems better supported. It is possible that in general the most probable response at low dosage is a sigmoid relationship somewhere in between the linear and threshold models. (auth)

24337 (COO-1487-6) HISTOPATHOLOGICAL CHANGES IN LABORATORY ANIMALS EXPOSED TO PROTACTED LOW-LEVEL TOTAL-BODY NEUTRON AND GAMMA RAY FLUXES: A CONTINUING STUDY. Technical Progress Report, June 15, 1970–June 14, 1971. Rust, John H. (Chicago Univ., Ill.). 1 Mar 1971. Contract AT(11-1)-1487. 12p. Dep. NTIS.

The induction of myelogenous leukemia with single exposures to neutron irradiation and x rays in a mouse strain which shows no such disease, either in unirradiated or protracted gamma irradiated, raises some interesting questions about the etiology of the disease. The results for the incidence of tumors of the liver and of the single tumor of the gall bladder after irradiation suggest that this method of altering proliferation in these cell systems will be useful for investigating the interrelation of proliferative activity and radiation induction of tumors. (auth)

24338 (JPRS-52402, pp 9-16) EXPERIMENTAL VALIDATION OF ADMISSIBLE RADIATION DOSES FOR LONG SPACE FLIGHTS. Grigor'ev, Yu. G.; Markelov, B. A.; Popov, V. I.; Akhunov, A. A.; Ilyukhin, A. V.; Tsessarskaya, T. P.; Sedov, A. V.; Korsakov, V. A. Translated from Kosm. Biol. Med.; 4: No. 6, 9-14(1970).

The results of a two-year study of 204 dogs exposed to chronic γ irradiation are given. Total tissue doses were 42, 125, and 249 rad. Some of the animals were exposed to repeated irradiation for four months in addition to chronic irradiation with a dose of 62.5 rad per yr. Total absorbed tissue doses from exposure of the two groups to the combined irradiation were 241 and 377 rad. The dose level and exposure rate simulated irradiations that may occur during long space flights. The studies included determinations of hemopoietic, cytological, and immunological parameters. (JPRS)

24339 (JPRS-52402, pp 17-22) PATHOLOGIC ANATOMY OF DOG KIDNEYS DURING THE AFTEREFFECT PERIOD FOLLOWING IRRADIATION BY HIGH-ENERGY PROTONS. Fedorenko, B. S.; Shikhodyrov, V. V.; Ryzhov, N. I.; Oparina, D. Ya. Translated from Kosm. Biol. Med.; 4: No. 6, 14-18(1970).

Renal pathologic anatomy of 17 dogs irradiated with 126- and 510-MeV protons in doses of 250, 350, and 550 rad was investigated two to four yrs after the exposure. Dystrophic and sclerotic changes observed in the glomerular and tubular system included enlargement of basal membranes and the glomerular capsule, atrophy of the tubular epithelium, and excessive accumulation of mucopolysaccharides. The degree of structural changes increased with the irradiation dose regardless of proton energy. These changes were slowly progressing to involve mainly vascular disorders and lesions of the interstitial substance of glomerular basal membranes. The changes were similar to the processes involved in natural aging of the animal body. No specific results of proton exposure were noted. (JPRS)

24340 (JPRS-52488) BIOELECTRIC ACTIVITY OF VARIOUS STRUCTURES OF THE RABBIT BRAIN UNDER THE COMBINED ACTION OF RADIOACCELERATION AND IRRADIATION. Akopyan, S. A.; Baklavadzhyan, O. G.; Grigoryan, S. S. Translated from Biol. Zh. Arm.; 23: No. 10, 3-12(1970). 11p. NTIS.

Investigations were made on the combined effects of centrifugation and x irradiation on bioelectric potentials in various zones of the cortex of rabbits, the reticular formation and hypothalamus,

and the threshold and duration of spasmodic activity. The rabbits were given whole-body radiation doses of 700 to 800 R. (P.B.M.)

24341 INFLUENCE OF LEUKOCYTIC FACTORS OF INTACT AND X-IRRADIATED ANIMALS ON THE LEUKOCYTE MIGRATION. Koroleva, L. V.; Tsyran, N. I. (Inst. of Medical Radiology, Obninsk, USSR). Byull. Eksp. Biol. Med.; 70: No. 12, 31-2(Dec 1970). (In Russian).

Leukocytic factors (lysosomes, granulocytic substance and destroyed leukocytes), isolated from polymorphonuclear leukocytes of the peritoneal exudate of intact and x-irradiated rabbits and rats, upon intradermal injection provoke an active leukocyte migration. The leukotaxic activity of preparations from leukocytes derived irradiated animals is lower by 2½ to 6 times than the activity of corresponding preparations from leukocytes of nonirradiated animals. (auth)

24342 CHANGES IN THE MOLYBDENUM CONTENT IN THE RABBIT ORGANS UNDER THE EFFECT OF X-RAYS. Luk'yanchuk, I. I. (Medical Inst., Odessa). Ukr. Biokhim. Zh.; 42: 621-3(1970). (In Ukrainian).

The effects of x radiation doses of 450 R on the level of molybdenum in organs of rabbits was studied after 6 hrs and 1, 3, 7, 15, and 30 days. The trace element from the ash solution was isolated by means of isoamyl alcohol as a rhodanide complex and was determined by the photoelectrocolorimetric method. It was established that x rays cause quantitative changes in the molybdenum content in the liver, kidneys, small intestine, muscles, and whole olood. The character of changes for various organs was different and depended on time which passed after the effect of rays. (auth)

24343 RESTORATION OF CORTEX IN AUTOTRANSPLANTED ADRENALS FOLLOWING X IRRADIATION IN VITRO AND ENUCLEATION. Truupyl'd, A. Yu. (Tartu State Univ. Inst. of Experimental Medicine, Leningrad). Arkh. Anat., Gistol. Embriol.; 59: No. 10, 51-8(Oct 1970). (In Russian).

Adrenocortical regeneration was investigated in rats with autografted enucleated adrenals after their preliminary exposure in vitro to 500, 1000, 2000, 3000, or 5000 R doses. Ten days after transplantation, in grafts exposed to 500 to 2000 R, as in unirradiated grafts, islets of poorly differentiated and actively adrenocortical tissue were seen, while in grafts irradiated at 3000 to 5000 R dose there were only clumps of surviving cortical cells with signs of dystrophy and necrobiosis. At 30 days, unirradiated grafts, as well as those exposed to 500 and 1000 R, consisted of nodes of regenerating cortex, differentiated into glomerular and reticular zones. After exposure to 2000 R dose, nodes of cortical regeneration were small, failing to differetiate into zones and showed signs of secondary necrosis. After exposure to 3000 and 5000 R, grafts were mainly found to consist of connective tissue and un-resorbed necrotic matter. Thus, after exposure in vitro to 500 or 1000 R, the adrenal cortex was found to regenerate as well as in unirradiated control grafts. Exposure to 2000 R caused considerable arrest and at 3000 and 5000 R doses practically complete supression of reparative regeneration of the cortical layer in autografts of the enucleated adrenal. Under these conditions, impairment of the regenerative process should not be attributed entirely to direct radiation injury of adrenocortical cells (suppression of mitoses and their appearance in pathologic forms), but also to failure of conditions, essential for regeneration (impared circulation due to defective development of connective tissue). (auth)

24344 A STUDY OF CHANGES IN THE NEUROMUSCULAR APPARATUS OF THE RAT IN CHRONIC EXPOSURE TO ^{54}Mn AND EXTERNAL GAMMA IRRADIATION. Znamenskii, V. V. (Inst. of Occupational Hygiene and Occupational Diseases, Moscow). Gig. Tr. Prof. Zabol.; 12: 46-50(Mar 1968). (In Russian).

A comparison of the effects on rats of chronic internal ^{54}Mn at a dose of 11.5 μCi/Kg and prolonged external γ irradiation at a comparable dose revealed differences in their effects on the central nervous system. Chronic internal exposure (12 mon) to ^{54}Mn at the stated dose led to a reduction in neuromuscular excitability in the rats. (tr-auth)

24345 BIOLOGICAL ACTION AND KINETICS OF ACCUMULATION OF ^{90}Sr IN THE ORGANISM OF CATTLE. Kruglov, V. T.; Burba, L. G.; Korenkov, I. P. Veterinariya; 46: 50-3(Dec 1969). (In Russian).

During chronic dosing of cattle, the amount of ^{90}Sr in the critical organ (bones), was 6% of the daily introduced dose; the total radiation dose to the skeleton over a 2 yr period was 5 to 8 krads. In calves, the skeletal dose for the same period of time was significantly high; radiation doses to the soft tissues were 0.3 to 1% of the total skeletal dose. In cattle irradiated with ^{90}Sr, typical changes, including injuries to the primary bone marrow, were noted. As a result of prolonged internal ^{90}Sr irradiation in the body of calves, unusual pathological changes were established due to the acute reduction and decompensation of the immunobiological reactiveness of the animal, leading to sudden death with clearly expressed hemorrhagic syndrome, necro distrophic changes, and microbialization of tissues and organs. Immediate causes of death in some instances included pneumosepticemia, and in time, lung abscesses together with subcutaneous cellulose, suppurative serositis, enteritis, and encephalomyelitis. (tr-auth)

24346 MIGRATION OF TRANSPLANTED HEMATOPOIETIC STEM CELLS TO THE SPLEEN OF IRRADIATED MICE. Boggs, Dane R.; Chervenick, Paul A. (Univ. of Pittsburgh). Transplantation; 11: 191-2(Feb 1971).

The exteriorized spleen of mice was x-irradiated while the remainder of the animal was shielded. Splenic hematopoiesis was determined 10 days later by counting the number of macroscopic colonies in the spleen, by determining spleen weight, and by determining splenic uptake of ^{59}Fe injected 6 hr before sacrifice. One group of mice was injected with bone marrow cells one hr after whole-body irradiation, and at intervals up to five days the spleens were exteriorized and exposed at 750 R. It was found that there was an increasing number of spleen colonies as the time interval between transplantation and the second irradiation was lengthened; this suggested that more cells were available for migration to the spleen at later intervals due to proliferation of injected CFU cells. (H.L.W.)

24347 PARTICIPATION OF THE SYMPATHETIC AND PARASYMPATHETIC NERVOUS SYSTEMS IN THE MECHANISM OF ACTION OF MICROWAVES ON THE ABSORPTIVE CAPACITY OF THE KNEE JOINT. Yatsenko, M. I. Vop. Kurortol., Fizioter. Lech. Fiz. Kul't.; 34: 158-61(Mar-Apr 1969). (In Russian).

Excision of the vagus nerves increased the absorptive capacity of the knee joint in rabbits. Irradiation of the knee joint with 40 watt microwaves for 20 min following the excision increased the absorptive capacity to an even greater extent. The absorptive capacity of the knee joint was also increased immediately following excision of the sympathetic nerves. Microwave irradiation of the joint following excision of the sympathetic nerves also increased to an even greater extent the absorptive capacity of the joint. Vagosympathetic innervation participates in the regulation of the absorptive processes of the synovial envelope of the knee joint and in the transmission of impulses to the knee following the effects of high frequency physical agents on the organism. (tr-auth)

24348 EFFECT OF CYSTAMINE AND PARTIAL-BODY SHIELDING ON THE FUNCTIONAL STATE OF THE GASTROINTESTINAL TRACT OF IRRADIATED RATS. Krasnykh, I. G.; Razgovorov, B. L.; Tyutin, L. A. Kos. Biol. Med.; 3: 82(May-Jun 1969). (In Russian).

The tonicity and peristaltic evacuational function of the gastrointestinal tract were studied in 120 rats weighing 170 to 200 g. Prior to irradiation, they received radioprotective preparations of cystamine (100 mg/kg) intraperitoneally, or they were partially shielded (head or anterior portion of the abdomen) during irradiation. The animals were subjected to whole body γ irradiation to a dose of 840 R at a dose rate of 11.7 R/min. The source to skin distance was 100 cm. Disturbances were apparent in the tonicity and in the peristaltic evacuational function of the gastrointestinal tract in the irradiated animals. The introduction of cystamine during the first hour preirradiation strengthened the pyloric constrictions and intensified the disturbance of the peristaltic evacuational function of the stomach. Subsequently, cystamine expressed a radioprotective effect on the functional state of the remainder of the gastrointestinal tract. (tr-auth)

24349 PATHOGENESIS OF RADIATION-INDUCED RETINAL DYSPLASIA. Shively, James N.; Phemister, Robert D.; Epling, Glenwood P.; Jensen, Rue (Colorado State Univ., Fort Collins). Invest. Ophthalmol.; 9: 888-900(Nov 1970).

Retinal dysplasia in dogs, irradiated as neonates, resulted from a sequence that included necrosis, lysis, migration, ectopic mitosis, and tubule formation. Continuing necrosis of cells in the dysplastic neural retina for as long as six months after irradiation ultimately produced atrophic changes. (auth)

24350 DIFFERENCES IN THE RESPONSE OF LONG-EVANS, SPRAGUE-DAWLEY, WISTAR, AND SHERMAN RATS TO X-RAY INDUCED INCREASES IN LITTER SIZE. Hahn, Eric W.; Birrell, J. Douglas (Univ. of Rochester, N. Y.). Lab. Anim. Care; 19: 720-3(Oct 1969).

Virgin females of four stocks of rats with two different suppliers for three stocks were given whole-body x-ray exposures of 200,

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400, or 600 R during the metestrus prior to mating. Significant differences in average numbers of ovulations, implantations, and term fetuses were obtained at all levels of irradiation between stocks and/or between suppliers of two different stocks. There was no consistent response within stocks or within suppliers. (auth)

24351 CHANGE IN THE ACTIVITY OF LIVER ACID PHOSPHATASE FOLLOWING RADIATION INJURY TO ANIMALS OF DIFFERENT RADIOSENSITIVITIES. Chernykh, A. V. Vestn. Akad. Nauk Kaz. SSR; No. 1, 50-2(Jan 1970). (In Russian).

Variations in the activity of free acid phosphatase from the liver of rats at different times following irradiation at 300 to 500 R were previously reported. A relationship was demonstrated between radiation dose and enzymatic activity. The disturbances of the structural integrity of the lysosomes observed following x irradiation of animals are a function of the observed autolytic activity. By comparison, it is possible to distinguish disturbances in the activity of different types of acid phosphatases based on dose and time following irradiation. This method is used to study variations in the activity of acid phosphatase in the same organs of animals of different radiosensitivities. Mature guinea pigs, having an LD 50/30 of 400 R, were used as the radiosensitive animals, and hamsters, with an LD 50/30 of 900 R, served as the relatively radiostable animals. The animals were given a single irradiation from the RUM-11 at a dose rate of 180 R/min. The guinea pigs received doses of 100, 200, and 400 R, and the hamsters 400 and 1000 R. The results confirmed the proposition concerning the relation between the disturbance of the structural integrity of the lysosomes and the liberation of these hydrolases following irradiation. (tr-auth)

24352 ANIMAL EXPERIMENTAL STUDIES ON THE RADIATION INJURIES IN THE MANDIBLES OF FULL GROWN RABBITS. I. MORPHOLOGICAL AND HISTOCHEMICAL FINDINGS. Grimm, G. (Martin Luther Univ., Halle, Ger.). Deut. Zahn-, Mund- Kieferheilk.; 53: 307-35(Dec 1968). (In German).

Experiments were carried out with x rays between 60 and 180 kV on the lower jaws of adult rabbits. The results of histological and histochemical investigations of the irradiated bone material of test animals are reported. The course of bone cell decay and radiogenic vascular changes are especially described and their significance for the pathogenesis of osteoradionecrosis is estimated. (auth)

24353 EFFECT OF SMALL DOSES OF RADIOIODINE ON THE MOTILITY OF SPERMATOZOA IN VIVO ANIMAL EXPERIMENTS. Massalski, W.; Gorowski, T.; Janczewski, Z.; Chomicki, O. (Post Graduate Medical School, Warsaw). Radiobiol.-Radiother.; 11: No. 1, 41-4(1970).

The effects of small doses of ^{131}I given subcutaneously to mice on the motility of spermatozoa were studied. The doses of 0.05, 0.1, and 5.0 μCi were calculated in relation to the body weight in man, i.e. 0.1 μCi in the mouse would correspond to about 300 μCi in man. The epididymis contents were obtained and examined. The number and the motility of the spermatozoa were determined and stained smears were also examined. (auth)

24354 EFFECT OF OXAPHENAMIDE ON BILE SECRETION DURING EXPERIMENTAL RADIATION SICKNESS. Skakun, N. P.; Borisenko, A. A. Farmakol. Toksikol.; 32: No. 1, 71-3(1969). (In Russian).

Oxaphenamide (para-oxyphenylsalicylamide) action in doses of 25 and 50 mg per 100 g of body weight on the secretion and composition of bile prior to and 2 hours, 2, 7, 14, and 30 days after a whole-body x-ray treatment in a dose of 600 R was studied in experiments on 172 albino male rats. The results showed a sharply diminished degree and duration of the choleretic reaction and a decreased relationship between the level of the doses and the degree of the effect. Moreover, a paradoxic action could be observed, when in response to a smaller dose of the drug there developed a more marked reaction and vice versa, as well as transformation of a choleretic reaction into an anticholeretic one. (auth)

24355 UV RESISTANCE OF THE EYE CORNEA EPITHELIUM. Genter, E. I. (Inst. of Cytology, Leningrad). Tsitologiya; 13: 206-11(Feb 1971). (In Russian).

Two different cell types of the mouse line (C3H) were uv irradiated (λ = 250 nm); a primary culture of mouse embryonic fibroblasts, and basal cells of the cornea epithelium, with doses being 100 and 3000 to 12,000 erg/mm^2, respectively. The cytogenetic effect of uv was estimated by the frequency of chromosome aberrations (in anaphases). It was established that in fibroblast (irradiated in vitro) chromosome aberrations amounted to 13 to 17%. For the basal cells of the cornea epithelium (irradiated in vivo) these amounted only to 3 to 8% at 18 to 28 hr. At higher doses (12,000 erg/mm^2) and later periods (36 to 72 hr), the effect was even reduced. The basal cells of the cornea epithelium proved to be several times more resistant to uv irradiation than fibroblasts. The nature of different uv resistances of fibroblasts and of cornea epithelium is discussed, i.e. a possible relation between resistance phenomena and the power of dark and photoreactivation processes in vivo and in vitro. (auth)

24356 EFFECTS OF RADIATION ON THE FOETUS, NEWBORN AND CHILD. Brent, Robert L. (Jefferson Medical Coll. and Medical Center, Philadelphia). pp 23-60 of Late Effects of Radiation. /Fry, R. J. M. (ed.). New York; Van Nostrand Reinhold Co. (1970).

From Conference on Late Effects of Radiation, Chicago, Ill. See CONF-690559.

Studies were carried out dealing with the effects of x radiation on embryogenesis in rats. It was found that the effects of exposure to low-level x irradiation (50 to 100 R) were seen irrespective of the stage of gestation; death during the preimplantation period, malformations during the organogenetic period, and cell deletions during the fetal periods. Although lower doses have produced effects, the thresholds were not determined. (P.B.M.)

24357 EFFECTS OF RADIATION EXPOSURE IN THE THERAPEUTIC RANGE: TRUNCATED DOSES AND DOSE FRACTIONATION. Fowler, J. F. (Hammersmith Hospital, London). pp 65-83 of Late Effects of Radiation. /Fry, R. J. M. (ed.). New York; Van Nostrand Reinhold Co. (1970).

From Conference on Late Effects of Radiation, Chicago, Ill. See CONF-690559.

The pathological effects of x radiation exposure in the therapeutic range on pigs are discussed in terms of early and late skin reactions, myelitis, lung fibrosis, and the effects of dose and dose fractionation. (P.B.M.)

24358 PATHOLOGICAL CHANGES AFTER PROTRACTED EXPOSURE TO LOW DOSE RADIATION. Casarett, George W. (Univ. of Rochester, N. Y.). pp 85-100 of Late Effects of Radiation. /Fry, R. J. M. (ed.). New York; Van Nostrand Reinhold Co. (1970).

From Conference on Late Effects of Radiation, Chicago, Ill. See CONF-690559.

The late pathologic effects of long-term exposure of laboratory mammals (dogs, mice, rabbits, and rats) to γ and x irradiation at rates of 10-R per day are discussed. The effects of fractionated and single doses on mortality, induced neoplasms, and sperm count are compared. (P.B.M.)

24359 BIOLOGICAL EFFECTS OF PROTRACTED LOW DOSE RADIATION EXPOSURE OF MAN AND ANIMALS. Grahn, Douglas. (Argonne National Lab., Ill.). pp 101-36 of Late Effects of Radiation. /Fry, R. J. M. (ed.). New York; Van Nostrand Reinhold Co. (1970).

From Conference on Late Effects of Radiation, Chicago, Ill. See CONF-690559.

The effects of single and fractionated doses of γ and x radiation on mice are reviewed. Cysts, deaths, renal lesions, and tumors induced in the mice are discussed in terms of their significance in studies on man. (P.B.M.)

24360 INFLUENCE OF THE SPACE DISTRIBUTION OF ABSORBED ENERGY ON THE DEVELOPMENT OF RADIATION INJURY DURING IONIZING RADIATION FROM OUTSIDE. Darenskaya, N. G.; Avetisov, G. M. Radiobiol.-Radiother.; 11: No. 1, 27-34(1970). (In German).

In experiments on 750 rats the development of the clinical picture of radiation injury was analyzed in relation to the dose during partial irradiations by comparing the values of energy dose in the different regions of the body of the rat. The possibility of a prognosis of the course of radiation sickness following partial irradiation in the presence of sufficient dosimetric information is discussed. (auth)

24361 BEHAVIOR OF ASPARTATE AMINOTRANSFERASE (EC 2.6.1.1) AND ALANINE AMINOTRANSFERASE (EC 2.6.1.2) IN RAT SERUM DURING THE COURSE OF ACUTE RADIATION SYNDROME FOLLOWING WHOLE BODY X-IRRADIATION. Roesler, B. (Medizinische Akademie, Magdeburg, Ger.). Radiobiol.-Radiother.; 11: No. 1, 89-101(1970). (In German).

In examinations on male and female rats after whole-body x irradiation with doses of 400, 700, and 1000 R, respectively, the behavior of aspartate aminotrasferase and of alanine aminotransferase activity in the serum and in a second series after 700 R up to the 30th day after irradiation was studied. With both enzymes the activity in the serum was decreased during the gastrointestinal phase and the interval poor in symptoms. The hemorrhagic phase was also characterized by subnormal activity. Sex differences could not be observed. The causes and the possible practical importance of the results are discussed. (auth)

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24362 BLOOD SYSTEM REACTIONS UNDER CHEMICAL AND RADIOCHEMICAL EFFECTS. Goldberg, D. I.; Goldberg, E. D.; Golubev, I. V. (Tomsk Medical Inst., USSR). Patol. Fiziol. Eksp. Ter.; 12: 26-31(Sep-Oct 1968). (In Russian).

After administration of massive doses of cytotoxic preparations and following irradiation of animals with high doses of betatron radiation there was a depression of mitotic activity, and a change of chemo- and radioresistant reticular cells of the bone-marrow to the endomitotic cycle. Gigantic hemohistoblasts, retaining the capacity to differentiate into gigantic elements of myeloid series, were formed. Some hemohistoblasts retained the capacity for indirect mitosis but mitotic figures usually proved to be anomalic. Such a type of pathological regeneration represents a protective-adaptation mechanism, offering a possibility for reticular cells to resist chemical and radiation effects and to retain some capacity for further differentiation. (auth)

24363 CHANGES IN THE PROTEIN METABOLISM OF WHITE RATS WITH CHRONIC RADIATION SICKNESS. Antov, G.; Zlateva, M.; Dachev, B. Stomatologiya (Sofia); 51: 209-14(May-Jun 1969). (In Bulgarian).

The quantity of sulfhydryl groups and soluble proteins in the oral mucosa, tongue, and striated muscles of the cheeks and liver of white rats, in which chronic irradiation disease was induced after continued treatment with small doses of radiation, is discussed. It was established that the quantity of the tested protein components was progressively reduced, which pointed to serious disturbances in protein metabolism. The changes in the tissues of the oral cavity went hand in hand with the changes that occurred in other internal organs and pointed to a general disturbance in protein metabolism, that set in as a result of the ionizing radiation. (auth)

24364 ACTIVATION OF AMINO ACIDS FOLLOWING PRENATAL X-IRRADIATION IN THE DEVELOPING RABBIT BRAIN. Wender, M.; Zgorzalewicz, Bozena (Dept. of Neurology, Poznan, Poland). Folia Biol. (Krakow); 18: 343-51(1970).

The influence of prenatal x irradiation on activation of amino acids by sRNQ-aminoacyl synthetases was studied in the developing rabbit brain. Pregnant animals were exposed to a single dose of 150 R on the 18th day of gestation. Ionizing radiation, acting during the intrauterine development, induced in the newborn animals a marked depression of the amino acid activation by sRNA-aminoacyl synthetases. There were two types of alterations that occurred during the brain development following prenatal x irradiation. One, in which glutamic acid and glutamine were involved, was characterized by a transitory depression in activation rates of these amino acids in the early period of extrauterine maturation, followed by a restoration of these rates in the later phases of the brain development. The activation rates of some other amino acids remained permanently decreased throughout all the examined periods of onthogenesis. Prenatal irradiation of the rabbit exerted a marked influence on the initial stage of protein biosynthesis in the developing brain without inducing concomitant structural malformations or other anatomical changes. (auth)

24365 MAMMALIAN AND FROG PARS TUBERALIS IN SOME EXPERIMENTAL CONDITIONS INCLUDING X-IRRADIATION. Srebro, Z. (Inst. of Biomorphology, Krakow). Folia Biol. (Krakow); 18: 335-41(1970).

Cystic transformation of the pars tuberalis was frequently found in whole-body 800 R x irradiated rats. Cytological and structural changes in the pars tuberalis were also observed in Rana temporaria under some experimental conditions: extensive pyknosis following exposure to constant darkness at low temperature for 7 to 14 days, pseudoacinar formations and colloid accumulation in x-irradiated animals, and signs of hypertrophy and nucleolar enlargement in cases with cerebro spinal fluid loss after brain lesions. A huge cyst with a structure typical for mammalian pars tuberalis cysts was found at the base of the preoptic nucleus in an illuminated adult Rana temporaria. (auth)

24366 EPENDYMA, THE CYSTEINE-RICH COMPLEX-CONTAINING PERIVENTRICULAR GLIA, AND THE SUBFORNICAL ORGAN IN NORMAL AND X-IRRADIATED RATS AND MICE. Srebro, Z. (Inst. of Biomorphology, Krakow). Folia Biol. (Krakow); 18: 327-3(1970).

The effects of whole-body 800 R x irradiation on the ependymal lining of the third brain ventricle, the subfornical organ, and the periventricular glia containing cystine and cysteine-rich complexes was investigated in the rat and the mouse. A considerable increase in number of the periventricular cystine- and cysteine-rich glial cells was observed on the 7th postirradiation day. The specialized ependyma covering the median eminence and the nucleus arcuatus in the irradiated animals showed signs of increased transport and secretion. From these and former observations it is inferred that the periventricular glia containing the cystine- and cysteine-rich complexes forms a natural protective barrier in the brain against noxious blood-borne agents of a toxic, oxidant, and free radical character. Observations on irradiated and normal animals indicated that the subfornical organ is a pressoreceptor recording changes in the pressure gradient between the blood and the cerebro-spinal fluid. (auth)

24367 SURVIVAL AND REPOPULATION OF HEMOPOIETIC TISSUES OF IRRADIATED MICE TRANSPLANTED WITH BONE MARROW CELLS FROM CYCLOPHOSPHAMIDE TREATED DONORS. Takahashi, Hiroshi; Ohara, Kanji; Ohkita, Takeshi; Nakanishi, Sumio (Hiroshima Univ.). Proc. Res. Inst. Nucl. Med. Biol.; No. 11, 68-83(1970). (In Japanese).

The effects of bone marrow cell transplants, rich in young granuloid series cells, on the survival and repopulation of hematopoietic tissues of mice lethally irradiated with ^{60}Co γ rays were investigated. Transplants were obtained from donor mice following lethal doses of cyclophosphamide. The survival of the mice receiving transplants from donors injected with cyclophosphamide 5 days previously was almost the same as those receiving transplants from normal donors. The effects of bone marrow transplants from donors injected with cyclophosphamide 4 days prior to transplantation on the survival rate of host mice were reduced. The results suggest that differentiated, mature cells are the most effective for repopulation of hematopoietic tissues. (E.E.H.)

24368 COMBINED EFFECT OF FAST NEUTRONS AND γ RAYS IN MICE. Takeshita, Kenji; Antoku, Shigetoshi; Sawada, Shozo; Okanishi, Hirofumi (Hiroshima Univ.). Nippon Igaku Hoshasen Gakkai Zasshi; 29: 1320-6(Jan 1970). (In Japanese).

Approximately 1000 ddN female mice were studied to determine the effect of mixed irradiation of 14 MeV neutrons and ^{60}Co γ rays in terms of lethality and hematopoietic injuries. The $LD_{50(30)}$ of this mixed radiation in equivalent dose ratios based on RBE of neutrons and γ rays was 1040 Rem. The RBE of neutrons to γ rays was assumed to be 1.5. Comparing this dose with 870 Rem for ^{60}Co γ rays, an RBE of 0.84 was obtained from mixed radiation. When neutron dose was expressed in Rad instead of Rem, $LD_{50(30)}$ of the mixed radiation was 870 Rad the RBE was 1.0. According to Glasstone, an RBE of 1.0 for nuclear weapon neutrons is the best estimate obtainable at the present time. The results in the present study agree with Glasstone's estimate for neutron RBE in mixed radiations. When mice were exposed to a given biologically effective dose from mixed radiation in varying ratios, mortality was higher for neutrons and γ rays only than for the mixed radiation and gradually decreased as the ratios approached unity. The effects of mixed radiation on ^{59}Fe uptake by circulating whole blood and liver, and femoral marrow were additive regardless of mixture ratios. (Japan)

24369 PROBLEMY POSTLUCHEVOGO VOSSTANOVLENIYA. (Problems of Post-Radiation Recovery). Akoev, I. G. Moscow; Atomizdat (1970). 368p.

Problems concerning the recovery of organisms following ionizing irradiation are discussed. The general rules governing the development of the recovery processes under different conditions of irradiation are elucidated. The relations determining the effects of dose, dose rate, dose fractionation, and number of irradiations on the rate of recovery are established. The development of radiation injuries with time, detected by multiple irradiation and other techniques, is examined in connection with clinical and pathophysiological aspects. Factors determining the clinical manifestations of the radiation consequences are also examined, and elements of similarity and difference in the processes of injury development and recovery in different biological organisms are described. (tr-auth)

24370 PERVICHNYE MEKHANIZMY BIOLOGICHESKOGO DEISTVIYA PRONIKAYUSHCHEI RADIATSII. (Primary Mechanisms in the Biological Effects of Penetrating Radiation). Manoilov, S. E. Leningrad; Izdatel'stvo Meditsina Leningradskoe Otdelenie (1968). 184p.

Data from literature and studies on the primary mechanisms of the biological effect of radiation are summarized, leading to an analysis of early biochemical changes that take place in organs and tissues following whole body irradiation of animals with different doses of penetrating radiation. The book is intended for radiobiologists of different specialties, physicians, and biologists interested in the effects of radiation on animals. (tr-auth)

24371 MODIFICATION OF THE PROTECTIVE EFFECT OF HYPOTHERMIA BY HYPERBARIC OXYGEN DURING THE IRRADIATION OF MICE. Praslicka, Milan; Marko, Libor; Kalina, Ivan (Safarik Univ., Kosice, Czech.). Biologia (Bratislava); 24: 898-905(1969). (In German).

The effect of hyperbaric oxygen on the protective action of hypo-

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thermia during the irradiation of mice with doses of 500 to 600 R was studied. The breathing of pure oxygen by mice with body temperatures of 16°C during irradiation decreased the protective action of hypothermia observed during the breathing of air, but did not eliminate this protection completely. The breathing of oxygen had the same effects when it was simultaneously introduced intraperitoneally. The breathing of pure oxygen by mice, with its simultaneous introduction intrarectally, resulted in increased radiosensitivity and a maximum number of animal fatalities during this time mainly from hematopoietic death, and after this time, mainly from intestinal death. (tr-auth)

24372 DINAMIKA POSTRADIATSIONNOI GIBELI BIOLOGICHESKIKH OB'EKTOV. (Dynamics of Post-Radiation Death in Biological Organisms). Bychkovskaya, I. B. Moscow; Atomizdat (1970). 201p.

On the basis of results obtained using different organisms under different conditions of irradiation, a general rule governing the post radiation dying of biological organisms in populations (the stepwise relation between radiation dose and time of death) that previously applied only to mammals was established. It was shown that this relation is determined by the unequal radiosensitivity of critical systems and by the different rates of development of injuries. The mechanisms of this phenomenon are explained, and the value of the phenomenon in pathogenesis of radiation sickness is determined. Considerable attention is given to a discussion of information concerning injuries to various systems in mammals (hematopoietic, gastrointestinal, and cerebral syndromes). The possibility of influencing the dynamics of post radiation death in animals by changing the ratio of radiosensitivity of critical systems to the effect of certain conditions of irradiation and other agents is demonstrated. This is of practical importance in relation to the actions of different radioprotectives on the critical systems of organisms. Considerable attention is also given to the methods of analysis of radiation injuries in relation to lethality. Information is given that shows that to ignore the stepwise nature of injury can lead to essential errors in the interpretation of observed results. The book is designed for use by radiobiologists and specialists in the area of medical radiobiology. (tr-auth)

24373 CELL SURVIVAL AND GROWTH STUNTING IN IRRADIATED BONES. Kember, N. F. (Royal Free Hospital School of Medicine, London). pp 85-8 of Symposium Ossium. /Jelliffe, A. M. (ed.). London; E. and S. Livingstone (1970).

From Symposium ossium; London (4 Apr 1968).

The growth rate of a bone was calculated using a computer and the cell generation times measured in a ^{3}H-thymidine study. Predictions concerning the effects of a given dose of radiation were made using a computer. These were found not to agree with experimental results immediately after irradiation and the possible reasons for this are discussed. (UK)

24374 A COMPARISON OF THE CARCINOGENIC EFFECTS OF THE BONE SEEKING NUCLIDE, ^{241}Am AND ^{239}Pu. Bensted, J. P. M.; Taylor, D. M. (Inst., of Cancer Research, Sutton, Eng.). pp 211-14 of Symposium Ossium. /Jelliffe, A. M. (ed.). London; E. and S. Livingstone (1970).

From Symposium ossium; London (4 Apr 1968).

The incidence of bone tumors in rats given 7 μCi/kg of ^{241}Am was approximately 50%, compared with an incidence of 80% in rats given 2.9 μCi/kg of ^{239}Pu. It is suggested that maximum permitted levels for ^{241}Am should be revised. (UK)

24375 ACUTE RADIATION SICKNESS IN PIGS AND SHEEP. Pospisil, J.; Otoupal, P. (Charles Univ., Prague). Zentralbl. Veterinaermed., Beih.; No. 11, 9-15(1970).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

Described is the course of acute radiation sickness in pigs and sheep that were whole-body irradiated with doses of 600, 300, and 200 R of gamma radiation. The clinical course and pathologico-anatomical findings are stated in detail. Great attention is devoted to the present diagnostic possibilities of this sickness. (auth)

24376 TERATOGENIC EFFECT OF IONIZING RADIATIONS. Kriegel, Heinz (Gesellschaft fuer Strahlenforschung, Neuherberg, Ger.). Zentralbl. Veterinaermed., Beih.; No. 11, 36-41 (1970). (In German).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

On the basis of results of animal experiments, the question of teratogenic effects of ionizing radiations is discussed. Results show that apart from radiation dose, stage of embryo development in utero at the time of irradiation is important in determining the extent of damage. The effects of x-irradiation in different periods of gestation, pre-implantation, period of formation of the main organs and fetal period are discussed. Finally, the dose-effect curves for irradiation with 50 to 400 R on the 5th and 8th days of gestation in the mouse are described. (auth)

24377 DAMAGE TO FISH IN THE STAGES OF EMBRYONIC AND GONAD DEVELOPMENT BY IONIZING RADIATION. Feldt, W.; Buehringer, H. (Bundesforschungsanstalt fuer Fischerei, Hamburg). Zentralbl. Veterinaermed., Beih.; No. 11, 42-50 (1970). (In German).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

The time of irradiation is particularly critical in relation to its effects. The time of development in which the primordiae of the vital organs are established is a radiation-sensitive time and irradiation can produce irreversible damage at this period. Attempts are made to identify more precisely these critical periods and to reduce the radiation dose to levels below that producing irreversible damage. Histological and biochemical studies are to follow in order to explore the biochemical features involved in radiation damage. Facilities for this work are being provided in aquaria in a new institute and will enable both internal and external irradiation to be studied. (auth)

24378 DEPENDENCE OF RADIOSENSITIVITY OF DOMESTIC FOWL (GALLUS DOMESTICUS) ON ITS AGE. Prochazka, Zdenek (Veterinary Research Inst., Brno). Zentralbl. Veterinaermed., Beih.; No. 11, 51-5(1970).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

Through the study of the effects of LD_0 (600 R) and LD_{50} (1230 R) established earlier for New Hampshire chickens in relation to their age, it was found that the time of the chickens first week of life is a period of high and the time of the 2nd to the 3rd week a period of elevated radiosensitivity. At the age of 1 to 4 months a certain elevated radioresistance sets in that finally returns to the conditions found earlier in adult birds. In connection with this change of radiosensitivity the possible importance of the bursa of Fabricius for the birds resistance to radiation is discussed. (auth)

24379 INHIBITORY EFFECTS OF β-RAYS FROM $^{90}Sr-^{90}Y$ ON GONAD FORMATION IN EMBRYOS OF ORYZIAS LATIPES. Hyodo-Taguchi, Yasuko; Egami, Nobuo (National Inst. of Radiological Sciences, Chiba, Japan). Dobutsugaku Zasshi; 79: 185-7 (Jun 1970). (In Japanese).

Embryos of Oryzias latipes at seven different developmental stages were incubated at 23°C in tap water containing 0, 1, and 10 μCi of $^{90}SrCl_2$ per liter, respectively. Newly hatched fry of each group were continuously kept in the same water until sacrifice. On 30, 54, and 70 days after hatching, young were fixed in Bouin's fluid. Sections of their gonads were histologically examined. At 30 days after hatching, no significant differences in development and differentiation of the germ cells of male and female were found between ^{90}Sr-treated and control groups. At 54th or 70th day, however, abnormal structures of the ovaries were observed in females treated with 10 μCi of ^{90}Sr per liter. In males incubated in 10 μCi/l, the multiplication of spermatogonia was strongly inhibited and the testes without germ cells and containing oocyte-like cells were found. (auth) (Japan)

24380 EXPERIMENTAL SUBSTANTIATION OF ALLOWABLE RADIATION DOSAGE DURING EXTENDED SPACE FLIGHTS. Grigor'ev, Yu. G.; Markelov, B. A.; Popov, V. N.; (and others). Kosm. Biol. Med.; 4: No. 6, 9-14(Nov-Dec 1970). (In Russian).

The results of two-year studies of 204 dogs exposed to chronic γ irradiation are presented. Total mid-tissue doses absorbed were 42, 125, and 249 rads. Some of the animals were exposed to repeated irradiations with doses of 8 and 42 rads, in addition to a chronic irradiation with a dose of 62.5 rads per yr for four months. Total mid-tissue dosage absorbed as a result of exposure to mixed irradiations of the two groups was 241 and 377, respectively. The dosage value and rate of the exposures simulated irradiations that may occur in extended space flights. The studies included examinations of hemopoietic, physiologic, cytologic, and immunologic parameters. By the end of the two-yr experiment some dogs which received maximal doses developed changes that could be characterized as early symptoms of chronic radiation injury. (auth)

24381 PATHOLOGIC ANATOMY OF KIDNEYS OF DOGS DURING AFTER-EFFECTS OF HIGH ENERGY PROTON IRRADIATION. Fedorenko, B. S.; Shikhodyrov, V. V.; Ryzhov, N. I.; Oparina, D. Ya. Kosm. Biol. Med.; 4: No. 6, 14-18(Nov-Dec 1970). (In Russian).

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Renal pathologic anatomy of 17 dogs irradiated with 126 and 510 MeV protons at doses of 250, 350, and 550 rads was investigated 2 to 4 yrs after exposure. Dystrophic and sclerotic lesions were found in the glomerular and canalicular apparatus; enlargement of basal membranes and glomerular capsule, atrophy of canalicular epithelium, excess accumulation of mucopolysaccharides. The level of the structural changes increased with the irradiation dose regardless of the proton energy. The above changes were slowly progressing to involve mainly vascular disorders and lesions of the interstitial substance of basal membranes of glomeruli that resulted in sclerotic disturbances of glomeruli and adjacent tissues. These changes were similar to developments involved in natural aging of the animal body. No specific features of the proton exposure were noted. (auth)

24382 CHANGES IN THE NATURAL RADIORESISTANCE OF THE MOUSE AFTER HYPOXIA OF SEVERAL DAYS' DURATION: THE POST-HYPOXIC BEHAVIOUR OF STEM CELLS. Beran, M.; Tribukait, B. (Karolinska Institutet, Stockholm). Int. J. Radiat. Biol.; 19: 27-35(1971).

The bone-marrow contribution to the post-hypoxic changes in the radiosensitivity in mice was studied, using the endogenous and exogenous spleen-colony methods. After ten days of hypoxia the number of bone-marrow colony-forming units had decreased to about 60 percent. It began to rise on the second post-hypoxic day, reaching normal values on the third day and overshooting between the fourth and the sixth days. The lowest number of endogenous spleen colonies was detected when the radiation was given on the second post-hypoxic day. On the other hand, the repopulation in the bone-marrow seemed to improve after sublethal irradiation between the first and third post-hypoxic days. The dissociation between the behavior of the CFUs and the changes in animal radiosensitivity is discussed. Radiation was at 90 cm from a ^{60}Co source at 80 R/min. (auth) (UK)

24383 RESPONSE OF HAEMOPOIETIC COLONY-FORMING UNITS TO SINGLE AND SPLIT DOSES OF γ RAYS OR D–T NEUTRONS. Hendry, J. H.; Howard, Alma (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Int. J. Radiat. Biol.; 19: 51-64(1971).

The effect of single and split doses of ^{137}Cs γ-rays or D–T neutrons on haemopoietic stem cells irradiated in donor mice was investigated, using the spleen-colony technique. On the γ-ray survival-curve derived from colony-forming units from the femur, there was a shoulder characterized by an extrapolation number of 3.1 ± 0.7. Split-dose experiments demonstrated a sparing effect of γ-ray dose-fractionation, and survival curves obtained for the survivors at various times after a first dose of 200 rads (γ-rays) showed that a significant shoulder had reappeared within 5 hours of the first dose. An increased radioresistance was indicated, demonstrated by a trend towards higher D_0 values for the survivors, when they were irradiated at 5 hours, 8 hours or 20 hours after a 200-rad dose of γ-rays. A lower extrapolation number of 1.7 ± 0.5 was found for D–T neutrons, and split-dose experiments demonstrated that dose-fractionation had no significant sparing effect. (auth) (UK)

24384 RADIUM RETENTION AND TOXICITY IN MELANOCYTES OF THE EYE. Taylor, Glenn North. Salt Lake City; Univ. of Utah (1970). 128p. University Microfilms Order No. 71-3623.

Thesis.

The initial retention of ^{226}Ra for one eye was 0.071% of the injected dose at all dose-levels tested in adult beagles. The biological half-times for eye retention varied inversely with the amount of the injected dose and appeared to be a function of the degree of radiation-induced injury. Within the eye, nearly all of the radium was retained in the pigment granules of the respective melanotic tissues, including the tapetum lucidum. This localized retention pattern produced radiation-induced focal lesions that were restricted principally to the pigmented components. The highest dose levels (1.07 to 10.4 μCi^{226}Ra/kg) produced the most significant cytological effects. Qualitatively similar lesions were induced by ^{224}Ra, ^{228}Ra, ^{228}Th and, to a lesser extent, by ^{239}Pu and ^{90}Sr. Of the various endpoints in the radiation induced eye syndrome, neoplasia was the most ominous. All of the 24 tumors were melanomas which appeared after long latent periods. The highest incidence was observed in the dogs injected with relatively low dose levels of ^{226}Ra (0.0621 to 1.07 μCi^{226}Ra/kg), ^{228}Ra (0.0177 to 0.148 μCi^{228}Ra/kg), and ^{228}Th (0.0152 to 0.0302 μCi ^{228}Th/kg). They have not occurred in the ^{239}Pu or ^{90}Sr treated animals. All but one of the eye tumors arose in the ciliary body and the pigment epithelial layer tentatively appeared to be the primary point of origin. (Diss. Abstr. Int., B)

24385 POLYCATION-TREATED TUMOR CELLS IN VIVO AND IN VITRO. Moroson, Harold (Sloan-Kettering Inst. for Cancer Research, Rye, N. Y.). Cancer Res.; 31: 373-80(Mar 1971).

The effect of cationic polyelectrolytes on tumor cells was studied in culture and in mice with transplanted Ehrlich carcinoma or murine leukemia L5178Y in ascites form, with and without x irradiation. Homografted mice were randomly subdivided into control animals, which were untreated, and treated animals, which were given s.c. or i.p. injections of different polycations at nontoxic doses. Survival of solid Ehrlich carcinoma-bearing mice was significantly increased by high-molecular-weight polyethyleneimine, by polyvinylamine, and by polypropyleneimine at neutral pH administered as late as five days after tumor transplant, accompanied by a 10 to 40% reduction in takes of the solid tumor. Survival of mice bearing leukemia cells in ascites form was improved only by polypropyleneimine. Increase in survival also resulted if the polycation was administered up to nine days before Ehrlich tumor transplant, with no evidence of weight loss in the host at time of tumor transplant. Thus, cationic polymers may have effect by nonspecific stimulation of host immune response to transplanted cells as well as by direct electrostatic cytotoxic interaction with tumor cells. (auth)

24386 COMPARISON OF CYTOTOXICITY OF HYDROXYUREA IN NORMAL AND RAPIDLY PROLIFERATING EPIDERMIS AND SMALL INTESTINE IN MICE. Hennings, Henry; Devik, Finn (Univ. of Oslo). Cancer Res.; 31: 277-82(Mar 1971).

The cytotoxicity of hydroxyurea was studied in mouse epidermis and small intestine by determining the loss of thymidine-^{3}H-labeled DNA by both autoradiographic and biochemical methods. In the normal epidermis, hydroxyurea-induced cytotoxicity appears to be limited to some of the DNA-synthesizing cells, which are lost within 12 hr after hydroxyurea injection. Labeled cells that survive hydroxyurea treatment proceed through mitosis. A low dose of hydroxyurea, which inhibits DNA synthesis effectively for at least one hr, is not cytotoxic. In rapidly proliferating epidermis 18 hr after an application of croton oil, the duration of the inhibition of DNA synthesis by a given dose of hydroxyurea is somewhat reduced, and the loss of prelabeled DNA is greatly reduced. In contrast, the extent of hydroxyurea-induced cytotoxicity in the rapidly regenerating small intestine three days after whole-body x irradiation with 1000 R was only slightly less than that found under normal conditions. This difference between the number of cells killed by hydroxyurea in the two stimulated tissues may be related to the degree of increase in cell proliferation rate. The thymidine-^{3}H labeling index in croton oil-treated epidermis was increased more than 10-fold, while that in the small intestine of x-irradiated mice was increased less than 2-fold. (auth)

24387 CHANGE IN THE ULTRASTRUCTURE OF DOG MYOCARDIUM AT DIFFERENT PERIODS AFTER TOTAL GAMMA-RAY IRRADIATION. Mityushin, V. M.; Bespalova, L. A. (Inst. of Biophysics, Moscow). Kardiologiya; 10: No. 6, 95-9(Jun 1970). (In Russian).

The ultrastructure of myocardial cells of the left ventricle was studied in dogs at different stages of acute radiation sickness caused by whole-body gamma irradiation with a dose of 350 R. Electron microscopy revealed a varying degree of sensitivity and susceptibility to injury of the myocardial intracellular structures. The most labile components were the mitochondria. Destructive changes in mitochondria were already noted during the first hours after γ irradiation. The most resistant components were myofibrils and muscle nuclei, which were damaged only in the late periods of the experiment. (JPRS)

24388 EFFECT OF TRANSPLANTATION OF HOMOLOGOUS BONE MARROW ON THE NUCLEIC ACID CONTENT OF THE SPLEEN DURING ACUTE RADIATION SICKNESS. Koval, A. I.; Shamray, A. E.; Ruban, V. I. (Inst. of Otorhinolaryngology, Kiev). Vrach. Delo; No. 9, 103-7(Sep 1970). (In Russian).

Rats were exposed to lethal doses of x rays (800 to 850 R) and, 24 hours later, received homologous bone marrow transplants intravenously. Both the RNA and the DNA content of the spleen decreased sharply after irradiation. Restoration began on the 8th day and by the 30th day, both nucleic acids were at normal levels. All of the control animals that did not receive the bone marrow transplants also exhibited a marked decrease in the nucleic acids, especially by the 4th day, a slight increase until the 8th day, and then a steady decrease until the 12th or 13th day, when they died. (JPRS)

24389 EFFECT ON THE SENSITIVITY OF THE MOUSE TESTIS OF DIFFERENT OXYGEN TENSIONS DURING IRRADIATION. Hornsey, Shirley; Bryant, P. E.; Hedges, M. J. (Hammersmith Hospital, London). Int. J. Radiat. Biol.; 19: 21-6(1971).

The OER for mouse testis weight-loss after irradiation was

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obtained for the sensitive component of weight-loss (1.8) and the insensitive component (2.5). Irradiations were with 250 kVp x-rays or 7 MeV electrons at dose rates of 6-15 krads/min. The regression lines fitted to the high-dose data for animals breathing oxygen or nitrogen during irradiation, extrapolated to the same value at zero dose, indicating that the cells responsible for the insensitive component formed a fixed proportion of the population independent of oxygen-tension. The weight-loss in animals breathing 8 per cent oxygen during irradiation was the same as in animals breathing air. Breathing oxygen at 3 atmospheres pressure did not increase the sensitivity of either component of testis weight-loss and may decrease the insensitive component. (auth) (UK)

24390 EFFECT OF IRRADIATION ON EXPERIMENTAL METASTASES VIA LYMPH AND BLOOD STREAMS. Zeidman, I.; Fidler, I. J. (Univ. of Pennsylvania, Philadelphia). J. Med. (Basel); 1: 9-14(1970).

After immunodepression was produced in rabbits by x irradiation, V_2 carcinoma cell emboli were introduced into the veins of some animals and into lymphatics of others. Unirradiated control animals revealed an incidence of metastasis higher in the lungs than in the nodes. This difference was accentuated by irradiation. Treated animals revealed a further increase in incidence of lung metastasis and no change in node metastasis. Heavy irradiation over the lymph node failed to increase the incidence of node metastasis. Thus, the relatively low incidence of node metastasis appears unrelated to immune factors, and it is unlikely that the x ray induced increase in lung metastases was due to immunodepression, as the same degree of immunodepression was not associated with an increase in node metastasis. (auth)

24391 EFFECT OF PREDNISOLONE ON FATAL POST-IRRADIATION NEPHRITIS IN RABBITS. Caldwell, William L. (Vanderbilt Univ., Nashville). Radiology; 98: 431-3(Feb 1971).

Small doses of prednisolone were given to rabbits during and after a three week course of bilateral renal irradiation with ^{60}Co γ rays. Survival at six weeks and nine months postirradiation was adversely affected by prednisolone. The clinical significance of these data is uncertain, but similar investigations in primates would appear to be indicated. (auth)

24392 INFLUENCE OF RADIATION ON THE PATTERN OF HISTOLOGICAL CHANGES IN THE SPLEEN OF CHICKENS VACCINATED DURING THE EARLY STAGE OF ONTOGENESIS. Rodak, L.; Prochazka, Z. (Veterinary Research Inst., Brno). Int. J. Radiat. Biol.; 19: 1-12(1971).

A study was made of morphological and cytological changes in the spleen of 1- and 7-day-old chickens irradiated 24 hours before, or 48 hours after, antigenic stimulation. Irradiation was by exposure to 400 R for 66.6 min (6 R/min, 180 kV, 15 mA). The results show that the chickens' ability to respond to antigenic stimulation by the plasma-cell reaction develops in the first days after hatching. Irradiation 24 hours before antigenic stimulation was found to inhibit the development of plasma-cell reaction in the spleen of 1-week-old chickens. Irradiation of young, immunologically-immature chickens markedly delayed the development of germinal centres in the spleen, which constitute an important part of the immune system. (auth) (UK)

24393 EFFECT OF PREIRRADIATION OF RECIPIENT MICE ON THE PROLIFERATION OF TRANSPLANTED HEMOPOIETIC STEM CELLS. Shadduck, Richard K.; Rickard, Kevin A.; Howard, Donald E.; Stohlman, Frederick Jr. (Tufts Univ., Boston). Blood; 37: 330-9(Mar 1971).

Syngeneic bone marrow was transplanted into recipients either immediately or 2 days after lethal doses of irradiation. In the preirradiated animals, the plating efficiency of 2 per cent was significantly less than the 13 to 15 per cent observed in animals receiving the bone marrow inoculum immediately after irradiation. It is suggested that the lower plating efficiency reflects a less favorable microenvironment with fewer ecologic niches. Once growth of colony-forming units (CFU) commenced, the growth rate in the preirradiated group was more rapid so that by the eighth day the splenic content of CFU was similar in both groups. Possible mechanisms for the latter are considered and it is suggested that the differentiation in growth rate may be ascribed to regulation of stem cell growth through a short range cell-cell interaction. (auth)

24394 STUDIES OF MARROW TRANSPLANTATION, CHEMOTHERAPY, AND CROSS-CIRCULATION IN CANINE LYMPHOSARCOMA. Epstein, Robert B.; Graham, Theodore C.; Storb, Rainer; Thomas, E. Donnall (Univ. of Washington, Seattle. Public Health Service Hospital, Seattle). Blood; 37: 349-59(Mar 1971).

During a 4-year period 75 dogs with malignant neoplasms were referred by veterinarians to a medical research unit interested in the study of canine lymphoma and leukemia. Sixty dogs had lymphoblastic lymphosarcoma, six had leukemia, and nine had nonhemopoietic malignancies. Twenty-nine allogeneic marrow grafts were attempted following 1200 R of whole-body irradiation. Seven dogs with lymphosarcoma and one dog with anaplastic carcinoma survived beyond the first postirradiation week and demonstrated evidence of allogeneic marrow engraftment. All animals died, two following graft rejection, two with intercurrent sepsis and three of secondary disease. The two longest survivors, dying of secondary disease on days 46 and 60, were free of clinical or histologic evidence of tumor. Four dogs with lymphosarcoma were treated for 18 to 30 days with L-asparaginase. Rapid tumor regression was noted in all. Eleven dogs were treated with weekly intravenous cyclophosphamide. Moderate to marked node regression occurred in nine cases. Lymphocytes from normal dogs presensitized with tumor tissue were given by cross circulation to tumor-bearing hosts. Tumor regression occurred in two of five dogs. It was concluded that canine lymphosarcoma is a disease with uniform histologic and clinical features suitable for evaluation of therapeutic procedures in the treatment of a spontaneous malignancy in a randomly bred species. (auth)

24395 EFFECT OF FRACTIONAL IRRADIATION ON THE RADIOSENSITIVITY OF EMBRYONIC CELLS OF MICE LIVER. Nuzhdin, N. I.; Chudinovskaya, G. A.; Kitaeva, O. N. (Pushchino-on-Oka Inst. of Biological Physics, USSR). Dokl. Akad. Nauk SSSR; 194: 946-9(1 Oct 1970). (In Russian).

Radiosensitivity of the embryonic cells in the livers of mice during fractionated and single irradiation of pregnant mice was studied using female mice x irradiated with a single dose of 50, 100, and 150 R and fractionated doses of 150 R divided into 50 and 100 R at intervals of a few hours. The results showed chromosome aberrations following a single dose and a higher cell fragmentation after fractionated doses of irradiation. However, the number of bridge cells and fragmentations was less in the latter case. (R.V.J.)

24396 RELEASE OF HYDROXYPROLINE FROM GRANULOMA TISSUE COLLAGEN AFTER IRRADIATION IN VIVO. Dancewicz, Antoni M. (Inst. of Nuclear Research, Warsaw). Nukleonika; 15: 223-8(1970).

The release into incubation medium of hydroxyproline from tissue collagen of rat granuloma after whole body x irradiation with the dose of 1000 R was studied. The growth of granuloma was induced by the subcutaneous implantation of polyvinyl sponge. During the granuloma growth proline-U-^{14}C was administered to the animals in order to label the newly formed collagen. It was found that 24 hrs after irradiation significantly more radioactivity was released into incubation medium from granuloma tissue of irradiated rats than from the tissue of control nonirradiated animals. Six hrs after irradiation no differences could be found in comparison with the control animals. Appreciable fraction of the radioactive label was recovered as hydroxyproline. The concentration of radioactive hydroxyproline in the incubation medium was higher than in the controls also in the case of granuloma removed from animals 72 hrs after irradiation. The results obtained indicated that the onset and increase in collagen degradative processes in irradiated animals began between the 6th and 24th hr after exposure. (auth)

24397 RADIOBIOLOGICAL INVESTIGATIONS WITH FAST NEUTRONS. I. COMPARATIVE INVESTIGATIONS ON THE MORTALITY OF MALE MICE AFTER AN IRRADIATION WITH 15-MeV-NEUTRONS AND ^{60}Co-γ-RAYS. Langendorff, H.; Langendorff, M.; Metzner, R.; (and others) (Univ., Freiburg i. B. Heiligenberg Inst., Ger.). Atomkernenergie; 16: 255-60 (1970).

The effects of monoenergetic neutrons with an average energy of 14.7 MeV were investigated with respect to the mortality of male NMRI mice and compared with the effects of ^{60}Co γ rays. The average dose rate of the neutron radiation was 10 rad/min. Up to 50 animals could be irradiated simultaneously. Using an equal dose rate for the γ radiation an RBE value of 1.65 ± 0.03 could be measured for the $LD_{50/30}$. A mortality analysis is dependent on the time after the irradiation and yields a significant difference between the neutron and γ-irradiated mice. In average the death of animals irradiated with neutrons occurs earlier. The results are discussed by means of comparable data available in literature. (P.B.M.)

24398 MICROSPECTROPHOTOMETRIC STUDY OF HISTOENZYMIC REACTIONS IN RAT EPIDERMIS SUBJECTED TO 0.5 Mrads OF DEUTERON RADIATION. Cabrini, R. L.; Itoiz, M. E.; Mayo, J.; Smolko, E. E.; Klein-Szanto, A. J. P. (Comision Nacional de Energia Atomica, Buenos Aires). Int. J. Radiat. Biol.; 18: 415-21(1970).

The epidermis of new-born rats was irradiated with a deuteron beam of 26.5 MeV. 500 krads were delivered to 4 mm diameter

circular areas in the infraorbicular left side of the heads. Quantitative histochemical determinations of NADP diaphorase, glucose-6-phosphate dehydrogenase, and lactic and succinic dehydrogenase were performed, using a microspectrophotometric scanning technique, from 2 to 48 hrs after irradiation. There was no clear change with LDh and SDh. A clear increment was detected in both total content and mean concentration of NADP Diaph. and Gl-6-phDh. No evidence of a real enzyme decrease shortly after irradiation could be detected by the methods used. This could imply that no significant direct radiation effects occur to the enzyme molecules in vivo. (auth) (UK)

24399 COMPARISON OF THE RESPONSE OF TUMOUR AND NORMAL TISSUE IN THE MOUSE EXPOSED TO SINGLE DOSES OF FAST NEUTRONS OR ELECTRONS. **Hill, R. P. (St. Bartholomew's Hospital, London); Cheshire, P. J.; Lindop, Patricia J.; Field, S. B. Brit. J. Radiol.: 43: 894-7(Dec 1970).**

Spontaneous mouse tumors were exposed to single doses of fast neutrons or fast electrons. Their response was compared with the damage caused to the overlying skin to obtain a measure of the therapeutic ratio for fast neutrons. At low doses the neutrons showed a large therapeutic gain, which reduced to unity (i.e. no gain) for large doses. This result is discussed in terms of the proportion of hypoxic cells and oxygen concentrations in the two tissues. (auth) (UK)

24400 RELATIVE BIOLOGICAL EFFECTIVENESS OF FAST NEUTRONS FOR INTESTINAL DAMAGE. **Hornsey, Shirley (Hammersmith Hospital, London). Radiology; 97: 649-52(Dec 1970).**

Relative biological effectiveness (RBE) of fast neutrons from the Medical Research Council cyclotron are compared to 250 kVp x rays for intestinal damage. The RBE is higher at low doses and approaches a common value of 1.9 at neutron doses above 1,000 rads. This RBE curve for intestinal damage was compared with similar curves for skin damage, damage to growing cartilage, and damage to hematopoietic tissues. All curves show the same general relationship between RBE and dose but differ in absolute RBE value from tissue to tissue. Clearly, extrapolations of RBE value from one tissue to another are unjustifiable. (auth)

24401 DEVELOPMENT OF CALCIFICATIONS AFTER WHOLE BODY IRRADIATION IN DHT-SENSITIZED RATS. II. THE INFLUENCE OF VARIOUS DOSES OF GAMMA IRRADIATION. **Petyrek, P.; Mraz, J.; Vodicka, I. (Medical Research and Postgraduate Inst., Hradec Kralove, Czech.). Sb. Ved. Pr. VLVDU Hradci Kralove; 43: 17-29(1969). (In Czech).**

Twenty-five white rats were divided into five groups. Five days following irradiation rats from each group were treated by Oxymykoin Spofa (tetracycline antibiotic) 5 mg/100 g of body weight, and six days following irradiation they were killed. The accumulation and fluorescence of tetracycline in calcified tissues were studied in the ultraviolet light. The results showed that the calcifications (in duodenum, caecum) developed only after whole body irradiation by the dose of 500 R and 600 R. The whole body irradiation by the dose of 700 R and 800 R decreased the development of typic calcifications. Twenty white rats were divided into four groups. The accumulation of Ca in the heart and in the intestines was studied by means of manganometric titration method. The results showed that after the irradiation of the rats sensitized by DHT by the dose of 600 R the accumulation of Ca was twice higher than in the rats only sensitized by DHT. (auth)

24402 COMPARISON OF RADIOPROTECTIVE EFFECT OF SOME RADIOPROTECTORS ON POSTRADIATION WEIGHT LOSS OF SUBMAXILLARY GLANDS WITH THEIR EFFECT ON RAT LETHALITY. **Vodicka, I.; Petyrek, P. Sb. Ved. Pr. VLVDU Hradci Kralove; 43: 45-65(1969). (In Czech).**

The radioprotective effectiveness of cystamine, tetramethylcystamine, AET, cysteine, 5-hydroxytryptamine, and norepinephrine were compared using two indicators of radiation damage in rats: the weight loss of submaxillary glands on 4th day after whole-body gamma irradiation and the thirty days lethality after whole-body gamma irradiation. The DRF values (dose reduction factor) obtained by means of these two methods were nearly the same for everyone of tested radioprotectors. Cystamine, tetramethylcystamine, AEC, cysteine, and norepinephrine administered immediately after irradiation were without any effect as far as the submaxillary gland is concerned. (auth)

24403 LATE CONSEQUENCES OF WHOLE-BODY IRRADIATION. **Moravek, F. Sb. Ved. Pr. VLVDU Hradci Kralove; 43: 187-204(1969). (In Czech).**

A brief review is given on late somatic effects of ionizing radiation. Nonneoplastic and life-span shortening due to exposure are discussed. (R.V.J.)

24404 QUANTITATIVE SYSTEM FOR MEASURING THE EFFECT OF X RAYS ON CHICK DEVELOPMENT. **Billett, F. S.; Hamilton, L.; Giles, N. E. (Middlesex Hospital Medical School, London). Int. J. Radiat. Biol.; 18: 479-500(1970).**

Embryos from fertile Whitehorn eggs were irradiated in open dishes at room temperature with unfiltered x rays at a dose rate of 950 rads/min. After irradiation the dishes were closed, incubation was continued at 39°C, and the embryos were observed. Embryos were irradiated at different stages from full streak to two somites. Data on the number of somites formed after 22h in unirradiated embryos, which were explanted at different stages and for the corresponding stages exposed to 680 rads of x rays in air, are tabulated. The effects of different doses of x irradiation delivered to full streak embryos are listed. Somite development was strongly inhibited by x irradiation at all stages investigated, and this inhibition was dose dependent. (UK)

24405 RED CELL PRODUCTION IN THE CONTINUOUSLY IRRADIATED MOUSE. **Twentyman, P. R.; Blackett, N. M. Inst. of Cancer Research, Sutton, Eng.). Brit. J. Radiol.; 43: 898-902(Dec 1970).**

A study was made of changes in red cell production in the mouse undergoing continuous irradiation at 40 rads/day. There was an early rapid fall in hemoglobin level followed by a continuing gradual fall. The initial decrease in the incorporation of ^{59}Fe into circulating red blood cells was found to be due to a low reticulocyte count and not to any reduction in red cell production. The repopulating ability of femoral bone marrow fell drastically and reached 5% of normal after 3 wks of irradiation. By eight weeks, the rate of red cell production had risen to above normal levels, due to a large increase in splenic erythropoiesis which was additional to the normal level of erythropoiesis in the bone marrow. Continuous irradiation increased considerably the random rate of destruction of mature red blood cells. These results were compared with the response of rats to continuous irradiation at various dose rates. (auth) (UK)

24406 EFFECTS OF IONIZING RADIATION ON THE LENS WITH RESPECT TO ITS METABOLISM AS DETERMINED BY FACTOR ANALYSIS. **Bergeder, Hans-Dietrich. Doc. Ophthalmol.; 27: 176-82(1969). (In German).**

Lenses of guinea pigs were exposed in vitro to 90 kR of x radiation and oxygen consumption was determined. Irradiation showed the following effects: in embryonal lenses, O_2 consumption increased strikingly; lenses of young animals showed reduced oxygen consumption, corresponding to that of nonirradiated older controls; and lenses of old animals showed no significant difference between irradiated and nonirradiated specimens. In addition, the behavior of several enzymes was studied in irradiated and nonirradiated lenses. Aldolase activity underwent the most striking alteration through x radiation. (H.B.G.)

24407 SHIELDING THE THYMUS AREA DURING X-IRRADIATION: EFFECTS ON HEMOLYSIN FORMATION IN MICE. **Takada, Akikazu; Takada, Yumiko; Munson, Benjamin; Ambrus, Julian L. (Roswell Park Memorial Inst., Springville, N. Y.). RES. J. Reticuloendothel. Soc.: 9: 147-61(Feb 1971).**

The thymus area was shielded with lead during whole-body x irradiation of thymectomized or sham-thymectomized mice, and sheep red blood cells (SRBC) were injected the next day (day 0). Mice exposed to 600 to 800 R without shielding did not produce hemolysins 7 days after injection of SRBC, but mice with the thymus area shielded had almost normal production of hemolysins, regardless of the presence or absence of the thymus. An ultracentrifugation profile indicated the following: unirradiated control mice produced both 7S and 19S hemolysins at day 7; mice exposed to 800 R without thymus shielding produced neither 7S nor 19S antibodies at day 7; mice exposed to 800 R with thymus shielding produced only 19S antibody at day 7, but both 7S and 19S antibodies at day 14; and splenectomized mice irradiated with the thymus area shielded did not produce 19S hemolysin at day 7. Jerne's plaque test indicated that spleens of mice exposed to 800 R without thymus shielding produced no plaque-forming cells, but that spleens of mice with thymus shielding exhibited a number of plaques at day 7. These results may mean that 19S-forming cells or their precursors migrated from the shielded area to the spleen in 1 week after a large dose of radiation. (auth)

24408 ALL-UNION CONFERENCE ON NUCLEAR MEDICINE AND RADIATION PROTECTION, SECI, CZECHOSLOVAKIA, SEPTEMBER 14–18, 1970. **Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 1-317(1970). (In English and Czech). (CONF-700927).**

Forty-one articles are included; separate abstracts were prepared for 38. The remaining three articles were not in scope for NSA. Also, abstracts of 22 papers are given. (P.C.H.)

XUM

For abstracts of individual papers see: 24037, 24038, 24058, 24125, 24145, 24146, 24183, 24217–24224, 24227, 24307, 24308, 24409–24424, 24451, and 24482–24484.

24409 MODIFICATION OF TISSUE LIPID CHANGES OF RAT AFTER CONTINUOUS GAMMA IRRADIATION. Ahlers, L.; Ahlersova, E.; Sedlakova, A.; Praslicka, M. (P. J. Safarik's, Univ., Kosice, Czech.). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 5-6 (1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

Rats were irradiated with ^{60}Co γ rays at a dose rate of 60 R/day up to a total dose of 1500 R. Tissue lipids and blood glucose were analyzed one week after irradiation. Compared with the controls, free fatty acids remained increased in serum and adipose tissue; triglycerides increased in serum; phospholipids increased in serum, heart, thymus, and liver; and cholesterol increased in serum and liver. The blood glucose level reached the control value. (F.M.M.)

24410 CHANGES IN DEOXYRIBONUCLEOPROTEIN (DNP) COMPOSITION OF IRRADIATED AND NON-IRRADIATED MICE SPLEEN AND THYMUS AND THE ACTION OF HEPARIN ON ABOVE TISSUES. Cejkova, M.; Skalka, M.; Matyasova, J. (Inst. of Biophysics, Brno). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 25(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

The proportion of DNA, RNA, histones, and non-histone like proteins in deoxyribonucleo protein (DNP) in the spleen and thymus of mice following irradiation was studied. In both tissues a decrease of histones was observed. The action of heparin was also studied. (F.M.M.)

24411 INTESTINAL TRASPORT OF ^{14}C-LABELED PARA-AMINOBENZOIC ACID IN IRRADIATED RATS (SEROSA–MUCOSA DIRECTION. Fendrich, Z.; Kvetina, J.; Deml, F.; Vavrova, E. (Charles Univ., Hradec Kralove, Czech.). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 47-53(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

Rats were given 600 R of whole-body irradiation and the penetration of ^{14}C-labeled para-aminobenzoic and (PABA) through the intestinal wall was studied following intravenous administration into the lumen. The results showed a reverse penetration of ^{14}C PABA. A decreased transport in the serosa-mucosa direction was seen three days after irradiation. This decrease was significant in in situ tests but slight under in vitro conditions. Six days after irradiation, a significant increase was found in in situ tests while there was slight decreased transport under in vitro conditions. (F.M.M.)

24412 RADIOSENSITIVITY OF MICE AFTER ADMINISTRATION OF PHYSIOLOGICAL SALINE AND ITS DEPENDENCE ON THE SEASON. Filip, J.; Novak, L.; Misustova, J. (Inst. of Biophysics, Brno). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 55-62(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

The radiosensitivity of mice was studied following single administration of physiological saline (PS) at various intervals before irradiation with 800 R x rays. A high radioresistance was found at the 3-hour interval. It was also found that the season of the year greatly influenced the radiosensitivity of mice following PS administration. (F.M.M.)

24413 TO THE QUESTION OF CHANGED EFFECT OF d-TUBOCURARINE IN IRRADIATED ANIMALS. Grossmann, V.; Kvetina, J.; Peca, O.; Thanh, H. (Charles Univ., Hradec Kralove, Czech.). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 63-71(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

On the 3rd and 6th day following the irradiation of frogs with doses of 700 R, the effects of acetylcholine (Ach) were enhanced, This was probably due to the slightly diminished activity of cholinesterase and not to the changed contractability of muscle. The change in the physiological state of the neuromuscular plate of frogs rectus after irradiation could not alter the activity of d-Tubocurarine in this case because the affinity of this drug is many times higher in relation to acetylcholine. In rabbits the smaller changes of d-Tubocurarine effect when the contraction after electrical stimulation of the sciatic nerve is unchanged suggest that the liberation of Ach is diminished in irradiated animals. (auth)

24414 PROBLEMS OF EXPERIMENTAL 6-AZAURIDINE OROTURIA AS AN IRRADIATION TEST. Grozdanovic, J.; Truxova, G. (Health Inst. of Uranium Industry, Pribram, Czech.). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 73-80(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

Studies were made on previous reports that ionizing radiation may alter the intensity of Nucleic Acid (NA) synthesis both positively and negatively. It was found that shortly after exposure to whole-body γ and x irradiation the experimental animals showed a decrease of NA synthesis and hence a decreased oroturia on application of equal doses of 6-azauridine (6-AzUR) to control the irradiated animals. Since the main pathway of pyrimidine biosynthesis proceeds via orotic acid and orotidine 5-phosphate that occupies an important position in the metabolism of NA precursors, it was assumed that the experimental oroturia brought about by application of 6-AzUR may yield information on NA synthesis. It is further assumed that such a model application of 6-AzUR that is known to affect mainly orotidylic acid decarboxylase might provide data on the synthesis of pyrimidines even in biological objects irradiated repeatedly or chronically. The model of experimental azauridine oroturia used might serve as a test for the experimental post-irradiation syndrome. (auth)

24415 EFFECT OF ELLAGIC ACID AND EFFECT OF OTHER HAEMOSTATICAL COMPOUNDS ON POST-TRAUMATIC HAEMORRHAGE IN WHOLE-BODY IRRADIATED RATS. Klir, P.; Pospisil, J.; Skala, E.; Dienstbier, Z. (Charles Univ., Prague. Central Hospital, Prague). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 126-8(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

Rats were whole-body irradiated with a dose of 700 rad and then injected with ellagic acid, hemarctin, reptilase, or dicynone. The tails of the rats were then amputated and the effects of the compounds on hemorrhage was noted. Significant results were obtained with ellagic acid in irradiated and non-irradiated rats, and with reptilase in irradiated animals, but no significant differences were found with hemarctin or dicynone. (F.M.M.)

24416 ANALYSIS OF THE PRINCIPLE DEATH CAUSES OF MICE CHRONICALLY EXPOSED TO ^{226}Ra. Kofranek, V.; Onyskowova, Z.; Holusa, R. (Inst. of Radiation Hygiene, Prague. Inst. of Industrial Hygiene and Occupational Diseases, Prague). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 129-34(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

Radium-226 was injected into mice in various doses. It was found that mice with the highest level of activity died within 16 months. The principal cause of death was determined during the long-term experiment. Hemoblastosis and epithelical tumors, especially Ca mammae, were observed in all experimental animals excepting those that received the highest dose. In mice of the lower activity level, cases of osteogenic sarcomas were found. (F.M.M.)

24417 COMPARISON OF SUPPORTIVE THERAPY WITH EFFECT OF BONE MARROW INFUSION IN WHOLE BODY IRRADIATED DOGS. Mraz, J.; Zachvej, J.; Moravek, F. (Purkyne Medical Research Inst., Hradec Kralove, Czech.). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 151-8(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

Whole-body exposure of dogs to a ^{60}Co γ radiation dose of about 300 R was near LD min. From this dose up to 900 R hematological radiation disease occur; $LD_{100/30}$ was near the dose of 400 R. After irradiation with 500 R no effect of supportive therapy on survival was observed. Of eight dogs irradiated with 500 R and treated with allogeneic marrow infusion and supportive therapy; two animals exhibited complete hemopoietic recovery, one of them survived; in three other dogs only transitory recovery of the white blood compartment was observed; and in the three remaining dogs the therapy remained without effect. Of eight dogs given 500 R, autologous marrow infusion and supportive therapy; five animals survived, 1 died on the 24th day (infection complication ?), and two died in the period that is characteristic for post-irradiation hematological syndrome. (auth)

24418 HISTOPATHOLOGICAL CHANGES OF IRRADIATION FROM INTERNALLY ADMINISTERED ^{106}Ru + ^{106}Rh IN DOGS. Petyrek, P.; Vondracek, V.; Moravek, F. (Purkyne Medical Research Inst., Hradec Kralove, Czech.). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 175-81(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

The degree of damage to the organism and the survival time depends on the amount of radioruthenium injected. The main

findings in dogs autopsied in the early period (30 days) after radioruthenium application were the manifestations of hemorrhagic diathesis of the bone marrow irradiation syndrome. In dogs autopsied in the late period (163 to 578 days) after radioruthenium application inflammatory and degenerative changes predominated with the maximum in the gastrointestinal tract, kidneys, and liver. (auth)

24419 CONTRIBUTION TO THE STUDY OF SURVIVAL OF ^{51}Cr LABELLED ERYTHROCYTES. Prouza, Z.; Pospisil, J.; Dienstbier, Z. (Charles Univ., Prague). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 197-202(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

It was found that whole-body irradiation in a dose of 600 rad did not cause any significant lesion of the membrane of rat erythrocytes that could result in an increased elution of radiochromium. This conclusion is not in contradiction with the findings concerning shortening of survival half-time (SHT) in whole-body irradiated rats. (auth)

24420 DIURNAL VARIATIONS IN THE RADIOSENSITIVITY OF THE HEMATOPOIETIC TISSUE IN MICE. Rotkovska, D.; Vacek, A.; akova, A. (Inst. of Biophysics, Brno). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 209-14(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

Mice were adapted to a 12 hr light and dark cycle or were kept entirely in the dark prior to whole-body x irradiation. The effects on endogenous spleen colony count were investigated. A diurnal change in the count was seen in mice adapted to the light and dark regime and the relation to the circadian cycle is discussed. (F.M.M.)

24421 CHANGES IN THE CONTENT OF SERUM ALBUMIN, TRANSFERRIN, CAERULOPLASMIN, GAMMAGLOBULIN, AND OTHER ALPHA AND BETA GLOBULINS IN SUBLETHALLY AND LETHALLY IRRADIATED RATS. Simsa, J. (Purkyne Medical Research Inst., Hradec Kralove, Czech.). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 235-40(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

With the aid of quantitative immunoelectrophoresis and simple radial immunodiffusion, changes in the concentrations of some proteins in female rats after irradiation were investigated. Animals were irradiated with 650 and 750 γ rays. Analysis were carried out during 30 days after irradiation. After irradiation with 750 R a significant increase was observed in the content of IgG, ceruloplasmin, haptoglobin, hemopexin, β globulin, and α-2 globulin. The maximum increase was between the 9th to 14th day after irradiation and was followed by a decrease to approximately normal values until the 30th day. The values for albumin, α-1-lipoprotein, and transferrin were only slightly changed. (auth)

24422 CONTRIBUTION TO THE PATHOGENESIS OF POSTIRRADIATION WEIGHT CHANGES OF THE SUBMANDIBULAR GLANDS IN RATS. Vodicka, I.; Kuna, P. (Purkyne Medical Research Inst., Hradec Kralove, Czech.). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 283-90(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

Thyroparathyroidectomy caused a distinct atrophy of submandibular glands in rats. A significant weight loss of this organ appeared on the 4th day after whole-body γ irradiation with 700 R only in intact and sham-operated animals but not in operated ones. The accumulation of ^{131}I in the thyroid gland and the weight of submandibular glands decreased on the 4th day after exposure of animals to 400, 650, and 900 R of γ radiation in a similar manner, that is, proportional to the increased dose. The results support the assumption that the weight loss of submandibular glands in the mentioned interval after irradiation is related to the hypothyreose accompanying the adaptation reaction in the irradiated organism. (auth)

24423 ACTIVITY OF PROTEOLYTICAL ENZYMES IN BLOOD SERUM OF WHOLE BODY IRRADIATED ANIMALS. Vranovska, J.; Pospisil, J.; Dienstbier, Z. (Charles Univ., Prague). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 291-4(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

In whole-body irradiated rats (with a dose of 800 and 200 rad) and in dogs irradiated with 600 rad a decrease of activity of serum cathepsin was found within the first 24 hours after irradiation. The lowest values were found in rats after 24 hours (after irradiation with whole-body doses of 800 and 200 rad), in dogs after 3 to 6 hr after whole-body irradiation. These findings were in agreement when both methods were used, the method of heteroproteolysis (HSA-^{131}I substrate) as well as the method of autoproteolysis. No significant changes in activity of serum cathepsins followed at pH 3.8 and 6.0 were found, either in rats or dogs. (auth)

24424 EFFECT OF CAFFEINE ON THE MOLECULAR WEIGHT OF THE DNA SYNTHESIZED IN L-CELLS AFTER UV-IRRADIATION. Zemanova, L.; Klimek, M. (Inst. of Biophysics, Brno). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 303-10(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

L cells were irradiated with a dose of 400 ergs/mm^2 of uv radiation and then labeled with ^3H-thymidine. Caffeine was added to the medium at a concentration of 2m Moles. Centrifugation in alkaline sucrose gradient was used to determine the molecular weight of DNA synthesized at 6 and 24 hr after irradiation. Graphs of the results are given. (F.M.M.)

Man

Refer also to abstracts 24053, 24063, 24066, 24118, 24119, 24149, 24153, 24156, 24189, 24243, 24268, 24277, 24284, and 24336.

24425 (BRH/DBE-70-6) RADIATION INCIDENTS REGISTRY REPORT, 1970. Mills, Loren F.; Segal, Phyllis (Bureau of Radiological Health, Rockville, Md.). Dec 1970. 54p. NTIS.

A list is presented of injuries to man reported during 1970 that resulted from exposure to ionizing or nonionizing radiations. Forty-one percent of all persons injured were exposed to nonionizing radiations. Exposures to ionizing radiations that resulted in injuries reported by 49 persons included: exposure during the operation of industrial x-ray units (24%), during the operation of dental and medical diagnostic x-ray units (22%), exposure during the operation of x-ray units in universities and laboratories (8%), and exposure to γ radiation (8%). (C.H.)

24426 (MIT-952-7) RADIUM AND MESOTHORIUM POISONING AND DOSIMETRY AND INSTRUMENTATION TECHNIQUES IN APPLIED RADIOACTIVITY. Annual Progress Report. Evans, Robley D. (Massachusetts Inst. of Tech., Cambridge. Dept. of Physics). May 1970. Contract AT(30-1)-952. 350p. Dep. NTIS.

Separate abstracts were prepared for the four sections presented. (W.H.K.)

For abstracts of individual sections see: 23770, 23858, 24129, and 24427.

24427 (MIT-952-7, pp 1-156) RADIUM AND MESOTHORIUM TOXICITY IN HUMAN BEINGS. (Massachusetts Inst. of Tech., Cambridge. Dept. of Physics).

In Radium and mesothorium poisoning and dosimetry and instrumentation techniques in applied radioactivity.

Medical data are summarized on 76 humans with known Ra body burdens with emphasis on the incidence of neoplasms and spontaneous bone fractures. Results of whole-body counting of a small group of the individuals are reported. Data are included from measurements on selected individuals including measurements of the ^{226}Ra and ^{228}Ra body burden, the cumulative α radiation dose to the sinus epithelium from Rn and Rn daughters estimated from measurements of Rn activity in breath samples, and post-mortem measurements of the content of Ra in the skeleton. Fortran computer programs developed for calculations of the cumulative radiation dose and other dose parameters for humans at various times following the uptake of ^{226}Ra and ^{228}Ra based on the decay scheme of the radioisotopes are described. (C.H.)

24428 THORIUM DIOXIDE GRANULOMA OF THE NECK. A DIAGNOSTIC AND THERAPEUTIC CHALLENGE. von Leden, Hans (Inst. of Laryngology and Voice Disorders, Los Angeles. Univ. of Southern California, Los Angeles). Arch. Otolaryngol.; 91: 520-3(Jun 1970).

From 11th Annual Meeting of the American Society for Head and Neck Surgery, New Orleans, La. See CONF-690349.

A patient with thorium dioxide granuloma of the neck had hoarseness as the only presenting symptom, 17 years after the injection of thorium dioxide (Thorotrast) into the left carotid system for angiography. (auth)

24429 LATE EFFECTS OF RADIATION. Proceedings of the Colloquium Held at Chicago, Illinois, May 1969. Fry, R. J. M.; Grahn, Douglas; Griem, Melvin L.; Rust, John H. (eds.). New

York; Van Nostrand Reinhold Company (1970). 306p. $10.95. (CONF-690559).

Abstracts were prepared for 12 papers included. (P.B.M.)

For abstracts of individual papers see: 24100, 24101, 24356–24359, and 24430–24435.

24430 EXPOSURE OF MAN TO RADIATION. Brill, A. B.; Johnston, R. E. (Vanderbilt Univ., Nashville). pp 1-21 of Late Effects of Radiation. /Fry, R. J. M. (ed.). New York; Van Nostrand Reinhold Co. (1970).

From Conference on Late Effects of Radiation, Chicago, Ill. See CONF-690559.

Information is given on the kinds and amounts of exposures currently being received by man and animals. The radiation considered include cosmic rays, natural radioisotopes, fallout, radioactive waste, radiation accidents, medical and occupational exposure, and television. (P.B.M.)

24431 LATE EFFECTS OF RADIUM DEPOSITION IN MAN. Hasterlik, R. J. (Univ. of Chicago); Finkel, A. J.; Miller, C. E. pp 173-90 of Late Effects of Radiation. /Fry, R. J. M. (ed.). New York; Van Nostrand Reinhold Co. (1970).

From Conference on Late Effects of Radiation, Chicago, Ill. See CONF-690559.

The effects of ^{226}Ra on man exposed occupationally or medically are reviewed. Many developed fibrosarcomas and osteogenic sarcomas of skeletal tissues, carcinomas and sarcomas of the mastoids and paranasal sinuses, and serious blood dyscrasias. (P.B.M.)

24432 LATE EFFECTS OF RADIATION FROM INTERNAL GAMMA AND BETA RAY EMITTERS. Nelson, Arne (Research Inst. of National Defence, Sundyberg, Sweden). pp 191-216 of Late Effects of Radiation. /Fry, R. J. M. (ed.). New York; Van Nostrand Reinhold Co. (1970).

From Conference on Late Effects of Radiation, Chicago, Ill. See CONF-690559.

The late carcinomas, leukemias, and osteosarcomas induced by cesium-137, iodine-131, and strontium-90 in dogs, man, mice, and rabbits were investigated. (P.B.M.)

24433 MODELS FROM RADIATION TOXICITY DATA. Sacher, George A. (Argonne National Lab., Ill.). pp 233-44 of Late Effects of Radiation. /Fry, R. J. M. (ed.). New York; Van Nostrand Reinhold Co. (1970).

From Conference on Late Effects of Radiation, Chicago, Ill. See CONF-690559.

Reviews are given on the use of mathematical models as descriptors and predictors of late radiation effects in animals and man. Convolution, a mathematical process by which the amount of injury arising from each exposure can be computed is discussed and the formula given. (P.B.M.)

24434 EPIDEMIOLOGICAL CONCLUSIONS FROM RADIATION TOXICITY STUDIES. Miller, Robert W. (National Cancer Inst., Bethesda, Md.). pp 245-56 of Late Effects of Radiation. /Fry, R. J. M. (ed.). New York; Van Nostrand Reinhold Co. (1970).

From Conference on Late Effects of Radiation, Chicago, Ill. See CONF-690559.

The epidemiology of delayed effects of radiation in man is reviewed and genetic effects on embryos, cytogenetic abnormalities in chromosomes, and cancers and leukemias in adults induced by atomic explosions in Japan are discussed. (P.B.M.)

24435 IMPLICATIONS AND APPLICATIONS OF RADIATION TOXICITY DATA TO OTHER ENVIRONMENTAL HAZARDS. Brues, Austin M. (Argonne National Lab., Ill.). pp 265-71 of Late Effects of Radiation. /Fry, R. J. M. (ed.). New York; Van Nostrand Reinhold Co. (1970).

From Conference on Late Effects of Radiation, Chicago, Ill. See CONF-690559.

The potential radiation hazard to the environment, occupational hazards to personnel, and medical hazards to patients are reviewed. Evaluation of acceptable levels of radiation exposure, linear dose-effect relations, and threshold levels are discussed. (P.B.M.)

24436 CARCINOMA IN SCAR TISSUE: A TOO RARE DIAGNOSIS. Pierer, H. (Chirurgische Univ., Graz). Langenbecks Arch. Chir.; 324: 315-32(4 Nov 1969). (In German).

Carcinomas in scar tissue (48 cases) were treated at the Surgical Clinic of Graz University between 1957 and 1968. They were seen in scars due to burns (7) and lesions (8), chronic ulcers (9), and fistulae (8). Radiation sequelae (16) were included in the series. Cancers in burn scars invariably occurred in contractures after 7 to 67 (44) years, often after long periods of ulceration. Carcinomas in scars after injuries mostly were observed on parts of the body exposed to repeated irritation and small insults after 20 to 45 (29) years. Ulcers of the leg in 0.8% of the patients showed malignant degeneration after 20 to 42 (34) years of existence. Carcinomas in fistulae were found 19 to 47 (35) years after suppuration began. The 103 cases of operated radiation sequelae included 12 squamous-cell carcinomas, are fibrosarcoma, and three basal cell epitheliomas. Time elapsed since radiotherapy, excluding three cases of occupational cancer, was 7 to 40 (25) years. The long period of latency and the increasing expectation of life explain the apparent increase in this rare cancer of scar tissue. Out of 46 cases operated on for scar cancers, the tumor was extirpated in 35 and the skin defect restored by plastic surgery. The 11 cases requiring amputations and the short survival time of 20 other patients are evidence that treatment was begun too late. Thus, not only must the time lag in diagnosing malignancy be shortened but above all prophylactic treatment for cancer with elimination of the precancerous conditions must be instituted. (auth)

24437 STUDY OF CHRONIC GRANULOCYTIC LEUKEMIA WI WITH SPECIAL REFERENCE TO A-BOMB SURVIVORS. Tsuchimoto, Taiso; Kamada, Nanao; Ishii, Yukifumi; Ozono, Noboru; Uch Uchino, Haruto (Hiroshima Univ.). Proc. Res. Inst. Nucl. Med. Biol.; No. 11, 132-7(1970).

Chromosome analyses and clinical and hematological studies were made on 27 cases with chronic granulocytic leukemia of which 5 were in blastic crisis. Twelve patients had been exposed to atomic bomb explosions. Ph(1) chromosomes were found in bone marrow cells from all patients with a frequency ranging from 62 to 100% of the cells. No difference was seen cytogenetically between the atomic bomb survivors and the nonexposed groups. These results failed to show a chromosome pattern peculiar to patients exposed to heavy radiation. Most of the patients in the early stage of the disease belonged to the exposed group, indicating the importance of periodic examinations for atomic bomb survivors. (E.E.H.)

24438 RADIOBIOLOGICHESKII EKSPERIMENT I CHELOVEK. (Radiobiological Experimentation and Man). Moskalev, Yu. I. (ed.). Mowcow; Atomizdat (1970). 208p.

The book is devoted entirely to the question of contemporary radiobiology: the transfer of experimental evidence obtained in animals to man. On the basis of this type of evidence, the permissible levels of irradiation and the maximum permissible concentration of internal sources were established and an evaluation of the consequences of irradiation at different doses during emergencies and under special conditions was conducted. The book is intended for use by a wide range of readers including; radiobiologists, clinicians, hygienists, physiologists, and other specialists. (tr-auth)

24439 RADIATION EFFECTS ON BIOLOGICAL OBJECTS, ESPECIALLY ON MAN. Fritz-Niggli, Hedi (Univ., Zurich). Neue Tech., B; 12: 183-8(Dec 1970). (In German).

Biological radiation effects are reviewed. Discussed are: general observations; changes in genetic material; morphologically and clinically demonstrable damages in man with respect to somatic injuries; maximal permissible dose; and radiation hazards resulting from nuclear power plants. (H.B.G.)

24440 INDUCTION OF BONE TUMORS BY IRRADIATION. Vaughan, J. M. (Churchill Hospital, Oxford). pp 199-203 of Symposium Ossium. /Jelliffe, A. M. (ed.). London; E. and S. Livingstone (1970).

From Symposium ossium; London (4 Apr 1968).

The significance of the distribution of radiation in relation to the cells at risk and the relationship of tumor induction to radiation dose is briefly discussed. A table is presented showing the long term effects of skeletal irradiation in four human groups: (a) bomb casualties, (b) American radiologists, (c) ankylosing spondylitis patients and (d) patients, radiation chemists, and dial painters, who have received internal radiation. A second table is given showing the incidence of bone cancer in beagle dogs injected with single doses of ^{226}Ra, ^{239}Pu, ^{238}Ra, ^{228}Th, and ^{90}Sr. The effect of $^{90}Sr-^{90}Y$ on the skeleton of dogs and pigs is mentioned. (UK)

24441 BONE CANCERS INDUCED BY EXTERNAL IRRADIATION. Chavanne, G.; Galle, R.; Gricouroff, G. (Fondation Curie, Paris). pp 204-7 of Symposium Ossium. /Jelliffe, A. M. (ed.). London; E. and S. Livingstone (1970).

From Symposium ossium; London (4 Apr 1968).

Tables are presented summarizing the observations of five radioinduced sarcomas arising in normal bone after radiotherapy at other sites, and two cases of radioinduced sarcomas occurring after irradiation of a benign lesion in bone. It is recommended that irradiation of benign lesions, particularly giant-cell tumors,

should be reserved for cases where surgery has failed or is impossible. (UK)

24442 RADIATION INDUCED OSTEOSARCOMA IN CHILDREN TREATED FOR RETINOBLASTOMA. Cassady, J. R.; Sagerman, R. H. (Columbia-Presbyterian Medical Center, New York). pp 208-10 of Symposium Ossium. /Jelliffe, A. M. (ed.). London; E. and S. Livingstone (1970).

From Symposium ossium; London (4 Apr 1968).

Nine osteosarcomas arising in children who had received external beam radiotherapy for retinoblastomas are described. Incidence appeared to be directly related to dose, but increasing dose did not affect the latent period between exposure and the appearance of the sarcoma. The difference in incidence between the cases in the series described and adults in other large series is compared and possible reasons for the differences briefly discussed. (UK)

24443 OCCUPATIONAL CHRONIC RADIATION INJURY OF MR. MASAHIDE NAGAO. Sasaki, Kiyoshi; Takeshita, Toshikazu; Ishibashi, Tatsuto; Takihara, Tetsuichi; Matake, Hidehisa (National Central Hospital of Fukuoka). Rinsho Hoshasen; 15: 712-16(Sep 1970). (In Japanese).

The case history of a man who died from radiation injuries resulting from chronic occupational exposure is reported. He began to handle x-ray equipment at the age of 18, and engaged in the installation and repair of it. At 42, radiation injuries of the skin appeared in both hands for the first time. At 43 and 59, he underwent amputation of the left middle and left ring finger respectively. Whether carcinoma existed at those times or not is not clear. At 60, a tumor appeared on the back of the left hand. At 61, this tumor was extirpated, and diagnosed as squamous cell carcinoma. At 63, an ulcer occurred on the right index finger, and this finger was amputated. At 65, metastases of cancer were found in the right infraclavicular and axillary region, and in spite of chemotherapy and radiotherapy, he became emaciated gradually, and died on August 29, 1969 at the age of 65. Autopsy revealed radiation injuries of the skin of both hands and the back, cancer metastases in the right infraclavicular region, lung edema, right pleural effusion, atrophy of the heart, liver and spleen, and ileocolitis. His exposure dose is unknown, but it is presumed that the dose to his hands reached several thousand R. (Japan)

24444 EFFECT OF IONIZING RADIATION ON THE PLASMA LEVELS OF CORTISOL AND CORTICOSTERONE IN HUMANS. Painter, Kent Howat. Lafayette, Ind.; Purdue Univ. (1970). 131p. University Microfilms Order No. 71-2664.

Thesis.

A method for the analysis of cortisol and corticosterone in human plasma was developed by combining a spectrophotofluorimetric method with a yield determination using radioactive tracers. The plasma of seventeen diverse cancer patients who were undergoing cobalt-60 γ radiation therapy was sampled on Mondays and Fridays during therapy. Radiation therapy treatments were usually administered Monday through Friday five days a week for periods of twenty-six to forty-three days. Results of the analysis of the plasma samples showed an initial decrease in cortisol and corticosterone levels which lasted from two to three weeks. For cortisol, the levels then increased above initial levels at about the twentieth day of therapy, and for the most part continued above initial levels for the remainder of the radiation therapy treatments. For corticosterone the levels appeared to rise gradually back to initial levels after four weeks. Although the above mentioned trends in cortisol and corticosterone levels could be shown quite clearly for the individual data of most of the patients, no statistical significance was obtained when the data for all the patients in the study was averaged on a treatment day basis. The diverse nature of the patients with regard to age, sex, type of cancer, stage of cancer, area of radiation therapy treatment, dose, time of sampling, and duration of sampling suggests that the data should not be treated as a single population. In all probability the patients studied represented several very different populations. (Diss. Abstr. Int., B)

24445 RECTAL REACTION FOLLOWING RADIATION THERAPY OF CERVICAL CARCINOMA: PARTICULAR REFERENCE TO SUBSEQUENT OCCURRENCE OF RECTAL CARCINOMA. MacMahon, Charles E.; Rowe, James W. (Swedish Hospital, Seattle). Ann. Surg.; 173: 264-9(Feb 1971).

Six cases of carcinoma of the rectum and recto-sigmoid subsequent to irradiation therapy of carcinoma of the uterine cervix are reported. The interval between irradiation therapy and appearance of a rectal neoplasm of up to 25 years suggests that patients with early proctitis, secondary proctitis, stenosis, or induration of recto-vaginal septum should be followed and examined for the presence of a rectal or recto-sigmoidal carcinoma. (auth)

24446 METABOLISM AND POSTIRRADIATION EXCRETION OF DEOXYCYTIDINE. Shejbal, Jindrich. Ann. Ist. Super. Sanita; 6: 46-61(1970).

Information about the excretion of deoxycytidine in mammals and man after irradiation is reviewed. Deoxycytidine-5'-monophosphate aminohydrolase and deoxycytidine aminohydrolase activities in human and animal tissues and leukocytes are compared. Evidence is reported for the existence of two individual enzymes responsible for the deamination of deoxycytidine and its monophosphate in humans. Possible implications on deoxycytidine excretion are discussed. It results that postirradiation deoxycytidinuria can hardly be expected to be a sensitive biodosimeter in man. Deoxyuridine and thymidine excretion in humans before and after local therapeutic irradiation was found not to exceed 10 μg per 24 hrs. (auth)

24447 INHIBITION OF ULTRAVIOLET-INDUCED HYDROXYPROLINE FORMATION IN HUMAN DERMAL COLLAGEN. Raab, W. P. (Univ., Vienna). Experientia; 26: 1061-2(15 Oct 1970).

Ultraviolet radiation provokes an increase in the hydroxyproline content of human dermal collagen. In addition to this uv-induced hydroxylation of proline, viscosity of collagen solution is reduced proportionally to the irradiation time. Experiments were carried out to test the inhibition of hydroxyproline by dipyridyl. (P.B.M.)

24448 VESICO-URETERIC REFLUX FOLLOWING INTERSTITIAL IRRADIATION OF THE URINARY BLADDER [ABRIDGED]. Williams, Grant; Wallace, D. M.; Bloom, H. J. G.; Stevenson, J. J. (Inst. of Urology, London. Royal Marsden Hospital, London). Proc. Roy. Soc. Med.; 64: 64-6(Jan 1971).

Vesico-ureteric reflux occurs in 58% of patients treated with interstitial radioactive implants for carcinoma of the bladder. In 78% of a small series of patients treated by open or transurethral removal of a bladder tumor without irradiation, reflux also occurred. Recurrent urinary infection was found in 25 out of 35 irradiated refluxing patients and in 11 out of 18 non-irradiated refluxing patients. This combination of vesico-ureteric reflux and recurrent urinary infection is potentially lethal. (auth)

24449 CHANGING END RESULTS IN PATIENTS WITH PAPILLARY CARCINOMA OF THE THYROID. Crile, George Jr. (Cleveland Clinic Foundation). Surg. Gynecol. Obstet.; 132: 460-8 (Mar 1971).

The results obtained in a personal series of 307 patients with papillary carcinoma of the thyroid were reviewed. Treatment was by conservative operations and thyroid feeding. Ninety-nine % of the 231 patients who had no previous operation on the thyroid underwent followup study from 5 to 33 yrs, a median period of 10 yr. Ninety-five % of the patients survived for 5 or more yr. Only 5 or 2% of the patients died of cancer. Two others are living 7 and 15 yr with advancing disease. The rest are well. Most of the cancers seen since 1937 occurred as a result of irradiation given in childhood for benign disease. This therapy resulted in a striking increase in the incidence of papillary carcinoma, in an equally striking reduction in the median age of the patients affected, and in the production of a type of cancer that was much more curable and much more suppressible by thyroid feeding than the ones that had occurred before. Since radical operations entail risk to life and inflict grave morbidity, neither total thyroidectomy nor radical neck dissection should be employed routinely, or perhaps even often, in the treatment of papillary carcinoma. (auth)

24450 PULMONARY DEPOSITION AND CLEARANCE OF ^{131}I-LABELED OIL AFTER LYMPHOGRAPHY IN MAN. CORRELATION WITH LUNG FUNCTION. Fallat, Robert J.; Powell, Malcolm R.; Youker, James E.; Nadel, Jay A. (Univ. of California, San Francisco). Radiology; 97: 511-20(Dec 1970).

Transport of ^{131}I-labeled Ethiodol through lung following lymphography was studied in 5 patients. Maximum deposition in lung occurred within 24 hrs in each instance, and, in 3, over 40% of total dose was found there. Clearance was slow and variable. Mean biologic half-life in lung was 8 days with a range of 5.2 to 12.6 days. Transport was slower in upper fields, seemingly correlating with blood flow. Diffusion capacity of lung was decreased 16 to 34% below control levels before lymphography. This decrease persisted even when much of ^{131}I-label cleared. (auth)

24451 ERYTHROCYTES OF URANIUM MINERS. I. FUNCTIONAL METABOLIC CHANGES. Vich, Z.; Novosad, F.; Brychtova, V.; Safandova, M. (Health Inst. of Uranium Industry, Pribram, Czech.). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 261-6 (1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

Increased activity of the pentose phosphate pathway, decreased activity of glucose-6-phosphate-dehydrogenase, and increased activity of glutathion-reductase were found in erythrocytes of uranium miners. It was suggested that the results are evidence of the changed functional status of erythrocytes caused by chronic radiation exposure of uranium miners, mainly as the compensation phenomenon of an oxidation effect of ionizing radiation. (auth)

24452 CASE OF CHRONIC MYELOID LEUKOSIS FOLLOWING MASSIVE X-RAY IRRADIATION OF THE THYMUS FOR MYASTHENIA. Petukhov, V. I. Probl. Gematol. Pereliv. Krovi; 15: No. 6, 53-4(Jun 1970). (In Russian).

A patient suffering from acute myothenia was treated with 800 R x radiation in 1959 and in 1964 he received three treatments of 4000, 3600, and 3000 R (10600 R total dose). Following treatment the patient developed a mild case of leukopenia, which quickly disappeared. However, in 1968 the clinical diagnosis revealed the presence of myelogenous leukemia. Observations of the patient's condition implicated the effects of x irradiation on the development of chronic myelogenous leukemia. (R.V.J.)

Radiation Effects on Plants

Refer also to abstracts 24005, 24012, 24039, 24040, 24042–24044, 24084–24086, 24090–24099, 24102–24117, 24122, 24123, and 24142.

24453 EFFECT OF RADIOPHOSPHORUS DECAY ON THE HAPLOID AND DIPLOID CELLS OF YEAST SACCHAROMYCES CEREVISIAE, OF DIFFERENT GENOTYPES. Gracheva, L. M.; Zheleznyakova, N. Yu.; Korolev, V. G. (Ioffe Inst. of Physics and Tech., Leningrad). Genetika; 6: No. 12, 101-6(Dec 1970). (In Russian).

The effects of ^{32}P decay on the haploid and diploid cells of yeast, Saccharomyces cervisiae, were studied. Wild-type haploid strain was used, and diploid strains were wild-type,uv-sensitive, and x ray-sensitive mutants. It was found that the lethal coefficient for haploid strains, uv-sensitive, x ray-sensitive, and wild-type strains of the diploid yeast were 0.016 ± 0.001; 0.0019 ± 0.0002; 0.0051 ± 0.0009; 0.0014 ± 0.0001, respectively. The survival curve followed the exponential law for haploid strain and for x ray sensitive diploid mutant and it was sigmoidal for uv-sensitive and wild-type diploid strains. The relation between the death rate and specific activity was linear. (auth)

24454 EFFECT OF LOW DOSES OF IONIZING RADIATION ON THE INITIAL GROWTH AND THE NITROGEN CONTENT OF SUMMER WHEAT. Brezinova, A.; Kralova, M.; Hosek, K. (Ceskoslovenska Akademie Ved, Prague). Rostlinna Vyroba; 16: 877-84(Aug 1970). (In Czech).

The effect of low doses of γ radiation (50 to 200 R) on the initial growth and on nitrogen content was studied in summer wheat (Triticum aestivum L.) under various conditions. The experiments did not prove that low doses affect the initial growth or the weight of the plants, either in the above ground parts or in the roots. The studied doses of ionizing radiation, however, affected the nitrogen content of the plant in relation to the magnitude of the dose, the duration of storage after irradiation, and the length of the vegetation period. (auth) (INIS)

24455 EFFECTS OF X RAYS ON HYBRID SEEDS OF WHEAT. Avakyan, V. A. (Academy of Sciences, Erevan). Dokl. Akad. Nauk Arm. SSR; 50: No. 1, 37-41(1970). (In Russian).

Considerable evidence was obtained supporting the idea that in the determination of x radiosensitivity in plants, the mutation of particular genetic components plays an important role as do the hybrid characteristics of the plant. (tr-auth)

24456 INDUCTION OF CHLOROPHYLL AND VIABLE MUTATIONS IN SORGHUM. Sree Ramulu, K. (Agricultural Coll. and Research Inst., Coimbatore, India). Genet. Agr.; 22: 323-34 (30 Jul 1970).

The spectrum of chlorophyll and viable mutations after treatments with x and gamma rays, chemical mutagens (EMS, MMS, DES, and NEU), and combined treatments was studied in three cultivated varieties of Eu-Sorghum. No relationship was observed between the frequency of chlorophyll and viable mutations and the dose of the mutagens. The treatments with EMS and gamma rays induced the widest spectrum of chlorophyll and viable mutations. (auth)

24457 DIFFERENCES IN COLD RESISTANCE INDUCED BY X RAYS IN WINTER WHEAT. Palenzona, D. L. (Univ., Bologna). Genet. Agr.; 22: 243-8(15 May 1969).

A study on the effect of ionizing radiations on the cold resistance in winter wheat, Triticum aest. vulgare, was made, considering the correlation between survival rate and three morphological characters. A statistically significant correlation was found in the plants grown under hard winter conditions, while the results suggest that a correlation between survival rate under hard winter conditions and morphological traits does not appear when the plants are grown under mild winter conditions. (auth)

24458 EFFECTS OF ^{60}Co GAMMA RAY RADIATION ON THE ACTIVITIES OF SOME ENZYMES IN STARKING DELICIOUS APPLE FRUITS. Harata, Junko; Osanai, Taka; Okamoto, Tatsuo (Hirosaki Univ., Aomori, Japan). Hirosaki Daigaku Nogakubu Gakujutsu Holoku; No. 16, 21-5(Mar 1970). (In Japanese).

Starking delicious apples and acetone powder prepared from them were irradiated by ^{60}Co γ rays with doses of 5×10^3, 1×10^5 R (fruits), and 5×10^3, 5×10^4, 1×10^5, 2×10^5, 5×10^5, 1×10^6, 5×10^6, and 1×10^7 R (acetone powder). L-Malate : NAD oxidoreductase (MDH), L-Malate : NADP oxidoreductase (decarboxylating) (ME), D-Glucose-6-phosphate : NADP oxidoreductase (G6PDH) and Shikimate : NADP oxidoreductase (SDH) activities of their acetone powder extracts were determined. In irradiated fruits, it was observed that the radioinduced change in activity of ME was more susceptible than that of MDH, but, no marked differences were observed in the changes of G6PDH and SDH activities. (auth) (Japan)

24459 FIFTH CONGRESS OF THE EUROPEAN ASSOCIATION FOR RESEARCH ON PLANT BREEDING, MILAN, SEPTEMBER 30–OCTOBER 2, 1968. Genet. Agr.; 23: 1-535(Dec 1969). (In several languages). (CONF-680981).

Forty-six papers are included. Separate abstracts were prepared for the 11 papers dealing with radiation effects on plant breeding. (P.B.M.)

For abstracts of individual papers see: 24005, 24091–24099, and 24460.

24460 USE OF IONIZING RADIATION FOR THE ALTERATION OF FRUIT TREES. Decourtye, L. (INRA, Angers, France). Genet. Agr.; 23: 166-75(Dec 1969). (In French).

From 5th Congress of the European Association for Research on Plant Breeding, Milan, Italy. See CONF-680981.

The usefulness of induced mutations in fruit trees is reviewed and the large number of cultivars, originated as natural bud sports, seem to be the best encouragement. This paper deals mainly with irradiation by gamma rays from cobalt 60 (2 to 6 kr) applied in the dormant stage to apple and pear scions. The sticks are topworked on old vigorous seedlings (discarded hybrids from the breeding program) and irradiated buds develop shoots during the next growing season. In summer, five successive buds are budded on clonal rootstocks and observed in nurseries and later in orchards. (auth)

24461 STUDIES ON THE RADIATION BREEDING IN THE GENUS MENTHA. 5. MUTATIONS OF MENTHA INDUCED BY X-RAYS. Ono, Seiroku; Ikeda, Nagamori (Okayama Univ., Japan). Okayama Daigaku Nogakubu Gakujutsu Hokoku; No. 34, 7-11(Oct 1969). (In Japanese).

Dormant seeds of Mentha arvensis L. var. piperascens MAL. (Japanese mint, 2n = 96) and those of induced tetraploid plant (2n = 192) were subjected to x ray treatment. They were treated at 200 kV, 19 mA, with 1.0 mm of aluminum filtration and a dose rate of approximately 110 R per minute. The whole dosage applied ranged from 5 kR to 20 kR. When the x ray dose was below 10 kR there were no striking differences in the germination rate of seed, growth of young seedlings, and the morphological characteristics of mature plants, between the irradiated plants and the control. At 20 kR irradiation the germination of seeds as well as the growth of seedling was reduced, delayed, and became uneven. Most of the chromosome aberrations found in the X_1-plants were tetravalent chromosomes. Univalent or fragmental chromosomes were also observed. Occurrence of the chromosome aberrations mentioned became more frequent as the dosage of x ray treatment increased and a linear relationship could be seen between them. The identical chromosome aberrations were often observed in two or three inflorescences of the same plant. As to the chromosome aberration and also in the germination rate of seed, the original Japanese mint suffered heavier damages following x irradiation than the induced tetraploid one, so the latter seemed to show a higher tolerance against x irradiation than the former. Among X_1-plants of which seeds were treated with 10 kR or 20 kR x irradiation there appeared also various kinds of morphological abnormality. (auth) (Japan)

24462 EFFECTS OF IONIZING RADIATION ON HYDROBIONTS AND LAND PLANTS. Petri, V. N. (ed.). Tr. Inst. Ekol. Rast. Zhivotn.; No. 74, 1-98(1970). (In Russian).

Investigations were conducted on the gamma radiosensitivity of selected freshwater plants and animals. Results are presented of radiobiological studies on gymnosperms that, by virtue of their high radiosensitivity, differ greatly from the other organisms studied. The modifying effects of magnetic fields on radiation injuries in plants were also studied. The following topics are represented: effects of radioisotopes on hydrobionts; effects of chronic irradiation on Esox lucius L.; effects of ^{60}Co γ radiation on embryonic development of pike; parameters of radiosensitivity in Tunica tunica L.; variations in radiosensitivity of Lymnaea stagnalis L. at different embryonic stages; effects of prior irradiation on accumulation of ^{90}Sr and ^{137}Cs by filamentous algae; effects of ^{60}Co γ radiation on seeds of selected gymnosperm species; effects of presowing irradiation of seeds on development of common pine seedlings; effects of chronic γ irradiation on growth and development of common pine seedlings; effects of chronic γ irradiation on distribution of labeled assimilants in common pine seedlings; effects of continuous magnetic fields on γ-irradiated common pine seedlings; effects of γ radiation and magnetic fields on mitosis in pea rootlet meristems; effects of continuous magnetic fields of different intensities on the cytogenetic effects of γ irradiation; and latent chromosome aberration frequency in root tip cells of γ-irradiated pea seeds. (tr-auth)

24463 EFFECTS OF SUCCESSIVE IRRADIATION OF SEVERAL GENERATIONS ON THE RADIOSENSITIVITY AND MUTABILITY OF DIFFERENT TYPES OF CORN. Valodzin, U. G.; Gardzei, I. A.; Gardzei, G. M. (Inst. of Genetics and Cytology, Minsk). Vestsi Akad. Navuk BSSR, Ser. Biyal. Navuk; No. 5, 69-75(1970). (In Belorussian).

It was shown that heterozygous tall corn hybrids were more resistant to a single γ irradiation than were the parent forms. Successive irradiation of four generations led to a decrease in the radiosensitivity and in the mutational variability of all types of corn studied. In the generation following the four successively irradiated generations, differences in the radiosensitivity and the mutability between the hybrids and their parents were not observed. It was concluded that upon irradiation of several generations, selection of the more radioresistant plants occurred thereby determining the decrease in radiosensitivity. (tr-auth)

24464 INVESTIGATIONS ON IRRADIATION BIOLOGY IN CEREAL SPECIES. V. THE INFLUENCE OF GROWTH FACTORS DEPENDENT ON ENVIRONMENT ON THE EXPRESSION OF RADIATION INJURY IN WHEAT VARIETIES DIFFERING IN RADIORESISTANCE. Walther, F.; Conrad, D. (Kernforschungsanlage, Juelich, Ger.). Z. Pflantzenzuecht.; 64: 20-9 (Aug-Sep 1970). (In German).

Air-dry dormant caryopses of two winter wheat varieties differing in resistance to irradiation were exposed to x rays at doses of 10 kR to 30 kR. The seedlings were grown in nutritive solutions and under differing conditions of environment. After 20 days of growth, the shoot in all experiments differed from the control in having a reduced fresh, dry, and ash weight together with an increased dry-matter content and a reduction in the percentage of inorganic matter in the dry weight. By calculating the variation coefficient it was shown that the variance of the individual values between experiments carried out in varying environmental conditions diminished with increasing dose, as long as lethal doses of irradiation were not reached. The reason for this is regarded as lying in the incapacity of the irradiation variants to utilize growth-promoting environmental factors for the production of organic material, this incapacity being induced by the irradiation. (auth)

24465 CYTOGENETIC STUDIES ON THE PROGENIES OF RICE PLANTS EXPOSED TO ATOMIC RADIATION IN NAGASAKI. Iwata, Nobuo (Kyushu Univ., Fukuoka). Kyushu Daigaku Nogakubu Gakugei Zasshi; 25: 1-53(Jul 1970). (In Japanese).

There are about a hundred progeny lines of rice plants descended from the plants which were exposed to atomic bomb radiation in Nagasaki in the laboratory of Kyushu University. These lines have been classified into some categories, including genic mutation lines and chromosome structure abnormality according to their genetic behavior or the characteristics of their abnormal progeny. Results are reported from cytogenetical studies carried out to clarify the complicated genetic behavior of the progenies of the rice plants exposed to mixed γ and fast neutrons. Based on observations of seed fertility, pollen fertility, and the chromosome behavior at meiosis in the F_1 hybrid, these chromosomal abnormalities were categorized into 5 original lines. Various cytogenetical studies were performed on each type. The occurrence of variant types and their genetic behavior during pedigree culture of these progenies of atomic bombed rice plants during a period of more than 10 years are discussed. (Japan)

24466 RESEARCH ON THE EFFECTS OF γ-RADIATION ON PLANT DEVELOPMENT AND LEAF CONFIGURATIONS IN TWO VARIETIES OF POTATOES. Bancher, E.; Washuettl, J. (Technische Hochschule, Vienna). Oesterr. Bot. Z.; 118: 216-25(1970). (In German).

The effects of ^{60}Co γ radiation on plant development and leaf configuration were studied for two potato varieties: Bintje and Sieglinde. Doses administered ranged from 0 to 5000 rad. With respect to both growth and height of the plants, Sieglinde displayed a strikingly higher sensitivity to γ radiation than Bintje, in which, even after 5000 rad, minimal growth was still observed. Well-known findings were confirmed with respect to interconnection of leaves, especially at higher plant levels, but not close to soil. (tr-auth)

24467 EFFECT OF GAMMA IRRADIATION ON GERMINATION AND SEEDLING GROWTH IN WHEAT. Rajput, Mushtaque Ahmad (Radiation Genetics Inst., Lyallpur, Pakistan). Nucleus (Karachi); 7: 178-82(Jul 1970).

Air dried seeds of 6 Mexican and local wheat varieties were exposed to 15, 20, 25, and 30 kR doses of γ rays from a 250-Ci ^{60}Co source. Germination and growth at seedling stage were determined. It was concluded that two local wheat varieties, C-273 and H-68, are more radiosensitive than the Mexican varieties, whereas C-591 showed similar sensitivity to γ radiation as the Mexican varieties. (auth)

24468 EFFECT OF ULTRAVIOLET IRRADIATION AND ATP ON HYDROXYLAMINE PHOTOOXIDATION AND HILL'S REACTION. Vaklinova, S.; Fedina, I. (Inst. of Plant Physiology, Sofia). Compt. Rend. Acad. Bulg. Sci.; 23: 1147-9(1970).

The inhibition mechanism of uv irradiation on the photochemical reactions of photosynthesis is studied using pea plants. Ultraviolet radiation damages chloroplasts, which lose their ability to photooxidize hydroxylamine (HA), destroys enzymes participating in ATP synthesis, and inhibits the Hill reaction. (P.B.M.)

Radiation Effects on Microorganisms

Refer also to abstracts 24039, 24205, 24408, 24489, 24496–24501, 24503, 24504, 24521, 24527, and 24530.

24469 EFFECT OF COMBINED TREATMENT WITH IRRADIATION, HEATING AND ANTIMICROBIAL AGENTS ON SPORES OF BACILLUS. Bomar, Miroslav T. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Zentralb. Bakteriol. Parasitenk., Abt. I Orig.; 213: 519-25 (1970). (In German).

The effects of combinations of different antimicrobial treatments namely irradiation with 250 Krad, heating to 80 or 100°C for up to 10 min and treatment with vapors of 8-hydroxyquinoline or phenylmercuriborat on the dry spores of Bacillus subtilis are described. It was found that the combination of two antimicrobial agents increased the inactivation of spores. The effect was synergistic and not additive. The best results were obtained by a combination of three antimicrobial agents, a further synergistic effect being observed in addition to the synergistic effect with the treatment by two agents only. Even with relatively low doses of the applied antimicrobial agents complete sterilization could be obtained. (auth)

24470 BALANCED GROWTH OF MICROCOCCUS RADIODURANS AND ITS RELATION TO THE CELL'S RADIATION RESISTANCE. Freedman, Michael Lewis. Buffalo; State Univ. of New York (1969). 123p. University Microfilms Order No. 70-17,323.

Thesis.

Unlimited balanced growth in batch cultures has been established in Micrococcus radiodurans. Changes in mass, DNA, RNA, protein, and colony-forming-units were followed over five different rates of growth in both defined and complex media. Changes in the content of cellular sulfhydryls which bind p-hydroxymercuribenzoate (HMB) were similarly studied. It was found that the cell was not unique when its growth characteristics were compared with other, more radiosensitive strains. The radioresistance of cells with compositions characteristic of balanced growth changes with rate of growth and macromolecular contents. Specifically, large rapidly growing cells which contained the greatest amounts of DNA, RNA, and protein and HMB-binding material were most sensitive to x irradiation. While possessing much the same D_Q doses, indicative of similar sub-lethal damage absorption and/or repair, the cells varied most in their D_0 doses, reflective of the rates of target inactivation. The extrapolation numbers, highest in rapidly growing cells, and the LD_{50} doses, highest in slowly growing cells,

XUM

led to the explanation of altered resistance on the basis of target multiplicity coupled with multiple hits in each target and possibly constant repair. While HMB-binding material may set this cell's range of radioresistance, such sulfhydryls did not appear to explain the response variations with changing growth rate. Also, the DNA-to-protein ratio, characteristically a constant with changing balanced growth rate, could not explain the altered radioresponse. Treatments which varied cellular composition support this observation, and only cells unbalanced by starvation increased their DNA-to-protein ratios and concomitantly their radioresistances. (Diss. Abstr. Int., B)

24471 INFLUENCE OF RECOVERY CAPABILITY ON LYSOGENICITY OF UV-IRRADIATED CELLS. Scherneck, S.; Theile, M.; Geissler, E. (Univ., Rostock, Ger.). Z. Allg. Mikrobiol.; 10: 637-45(1970). (In German).

At various times following uv irradiation, K_{12} strains of Escherichia coli were infected with λ+ phages. Subsequently, lysogenizing rates of the bacteria were determined. HCR– cells displayed no change in the rate of lysogenicity; whereas HCR+ cells exhibited a strikingly decreased value at an incubation time of 50 minutes. Results were explained by the suggestion of an induction hypothesis. (tr-auth)

24472 CONTROL OF DRIED SALMONELLA BY IRRADIATION. Bomar, M. T. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Arch. Lebensmittelhyg.; No. 5, 97-102(May 1970). (In German).

Egg powder was inoculated with salmonella typhimurium and irradiated with doses ranging from 10 to 1000 Krad. Following doses of 250 Krad, the germ count dropped 99%; following 500 to 1000 Krad, the decrease amounted to at least 99.9%. Germ growth could still be demonstrated between 4 and 24 hours following irradiation with 1000 Krad. Eight days later, no growth was observed. Subsequent to a storage time of 100 days, a dose of 1000 Krad was sufficient to eliminate all germs. (H.B.G.)

24473 LET EFFECTS IN MICROCOCCUS RADIODURANS IRRADIATED WITH α PARTICLES IN THE LIQUID PHASE. Kitayama, Shigeru; Igarashi, Kazui; Karasawa, Takashi; Matsuyama, Akira (Inst. of Physical and Chemical Research, Yamato, Saitama, Japan). Agr. Biol. Chem. (Tokyo); 34: 1346-54(Sep 1970).

Log- and stationary-phase cells of Micrococcus radiodurans, an extremely radioresistant vegetative bacterium, suspended in phosphate buffer were exposed to 16 MeV α particles from the IPCR cyclotron. The results obtained were compared with those for γ irradiation. Survival curves of M. radiodurans for α particles were found exponential while they were of sigmoidal or cumulative type for γ rays. In addition, the dose-rate effect was observed with α bombardment, although it was not found with γ irradiation. For a given dose, and in a system where the effective volume was sufficiently small as compared with the total sample volume, the relation of the surviving fraction to the beam intensity was represented by an empirical equation. By means of sedimentation analysis, double-strand scissions in DNA caused by α particles were found repairable during the postirradiation incubation, similar to the case following γ irradiation. The findings reported for M. radiodurans do not support the view that DNA is the only primary target for cell killing by α particles. (auth) (Japan)

24474 EFFECT OF IONIZING RADIATION ON THE BACTERIOPHAGE. Hradecna, Z. (Inst. of Biophysics, Brno). Biol. Listy; 34: 157-66(Aug 1969). (In Czech).

Published data on bacteriophage radiobiology are summarized and complemented by the author's findings. Special attention is given to mechanisms of virus inactivation, which is explained by damage of its genetic structure. Data on the role of protective agents during irradiation are summarized. It is pointed out that damage produced by ionizing radiation differs in nature from damage produced by uv radiation and repair processes are different for the two cases. It was concluded that radiobiology of the bacteriophage is still incomplete and that the findings in the types examined may not be of general validity. (NSA of Czech)

24475 MECHANISM FOR RADIATION LETHALITY IN MICROCOCCUS RADIODURANS. Kitayama, Shigeru; Matsuyama, Akira (Inst. of Physical and Chemical Research, Yamato, Japan). Int. J. Radiat. Biol.; 19: 13-19(1971).

After irradiation with doses which yield almost 100 per cent survival using ordinary agar plating methods [^{60}Co gamma-rays at room temperature (5.7×10^5 rads/hr)] the cells of M. radiodurans lost their colony-forming ability when the post-irradiation incubation was carried out in the presence of inhibitors of protein or RNA synthesis. Inhibitors used were chloramphemcol, actinomycin D and tetracycline. (auth) (UK)

24476 TWO TYPES OF LESIONS IN MACROMOLECULAR COMPONENTS OF E. COLI GAMMA IRRADIATED IN THE PRESENCE OF CHLORIDE IONS. Igarashi, Kazui; Matsuyama, Akira (Inst. of Physical and Chemical Research, Yamamoto, Japan). Agr. Biol. Chem. (Tokyo); 33: 289-91(1969).

From Collected Papers of the Institute of Physical and Chemical Research, Tokyo, 1268-70(1969).

To compare ^{60}Co gamma radiation damages to macromolecular components of Escherichia coli cells irradiated with or without 1M NaCl, sedimentation analyses on DNA and ribosomal subunits were carried out. The results indicate that the presence of Cl^- ions during irradiation increases single strand scissions in DNA, while it does not inhibit the repair process that rejoins broken pieces of DNA. (P.B.M.)

24477 RELATION BETWEEN RECOVERY FROM POTENTIAL LETHAL AND SUBLETHAL RADIATION LESIONS OF YEAST CELLS. Malinovskii, O. V. (Ioffe Inst. of Physics and Tech., Leningrad). Biophysik; 7: 17-24(1970).

Tetraploid yeast cells were used to study the time course of recovery from potential lethal lesions by delayed plating after a single dose of γ radiation and recovery from sublethal lesions by using two fraction dose technique. The mean lifetime of potential lethal and sublethal lesions in comparable conditions was the same. The elimination of lethals in the first steps of recovery process was accompanied by transition of lethally damaged cells into sublethally damaged ones. Sublethals were in principle completely reversible. In a time course, a definite fraction of potential lethals was fixed into true irreversible lethals. This pattern was in close agreement with the common model of formation of two-hit chromosome aberration. (P.B.M.)

24478 NO PROTECTIVE EFFECT OF PROCAINE HYDROCHLORIDE IN γ-IRRADIATED STATIONARY E. COLI B 163. L'Orange, R.; Schneeweiss, F. (Kernforschungsanlage, Juelich, Ger.). Biophysik; 7: 40-6(1970). (In German).

The improved repair of γ ray damage in animals and plants by procaine hydrochloride could not be confirmed on Escherichia coli. All survival curves up to γ doses of 30 krad, showed equal survival chances with or without addition of procaine hydrochloride in concentrations of 0.01 to 10 mmoles/l agar. Concentrations of more than 1 mmole caused growth inhibition, although this did not influence at all the surviving number of bacteria. Also the presence of procaine during irradiation in the phosphate buffer suspension had no effect on survival chances. (auth)

24479 INTERACTION BETWEEN DIEPOXYBUTANE AND ULTRAVIOLET LIGHT IN YEAST. II. EXPERIMENTS WITH UV-SENSITIVE AND RESISTANT STRAINS. Kilbey, B. J. (Univ. of Edinburgh). Mutat. Res.; 10: 525-31(Dec 1970).

The effects of diepoxybutane (DEB) pretreatment on uv inactivation were studied in yeast strain uvs-I which is sensitive to both uv and DEB. The effects of post uv treatment with DEB were also studied. (P.B.M.)

24480 EVIDENCE FOR THE REPAIR OF DOUBLE-STRAND SCISSIONS IN DNA OF MICROCOCCUS RADIODURANS AFTER ALPHA BOMBARDMENT. Kitayama, Shigeru; Karasawa, Takashi; Matsuyama, Akira (Inst. of Physical and Chemical Research, Yamato, Japan). Agr. Biol. Chem. (Tokyo); 33: 628-30(1969).

From Collected Papers of the Institute of Physical and Chemical Research, Tokyo, 1271-3(1969).

Investigations were done on alpha particle-induced double strand breaks in DNA of Micrococcus radiodurans and the ¢ mechanisms of repair. Survival curves and sedimentation patterns are given to show the effects of 26-MeV alpha bombardment. (P.B.M.)

24481 EFFECT OF RADIOACTIVE PHOSPHORUS AND SULPHUR ON INFECTIVITY OF TOBACCO MOSAIC VIRUS IN TISSUE CULTURE. Chatrath, M. S.; Raychaudhuri, S. P.; Mishra, M. D. (Indian Agricultural Research Inst., New Delhi). Proc. Indian Nat. Sci. Acad., Part B; 36: 126-9(Apr 1970).

Studies conducted to see the effect of radioactive phosphorus and sulphur on a strain of TMV (CPO Strain) in tissue culture showed that there is greater uptake of radioisotopes by virus affected tissues as compared to healthy ones, when grown on medium containing the radioisotope at an activity of 15 microcuries per ml. Quantitative data on uptake showed that it is more in differentiated tissue than callus only. Radioactive phosphorus at this dose had no effect on the infectivity while radioactive sulphur at the same dose inhibited the infectivity by about 90%. (auth)

24482 SURVIVAL OF MYCOPLASMA LAIDLAWII A AND CHANGES IN ITS DNA AFTER X-RAY IRRADIATION. Drasil, V., Liska, B. (Inst. of Biophysics, Brno). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 39-45(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

Cultures of Mycoplasma laidlawii were x irradiated and studies were made on survival, damage to DNA, and the ability to repair the damage. The survival curves showed that M. laidlawii is very sensitive to irradiation. It was concluded that after irradiation M. laidlawii released nuclease-type enzymes that caused splitting of its own DNA. (F.M.M.)

24483 EFFECT OF LOW DOSES OF ULTRAVIOLET RADIATION ON THE SENSITIVITY OF BACTERIOPHAGE TO X-RADIATION. Hradecna, Z.; Toufarova, D. (Inst. of Biophysics, Brno). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 91-6(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

The protective effect of low doses of uv radiation was studied in phage λ in relation to DNA content and radiation doses. It was found that the resistance of the phage to x radiation increased after low doses of uv radiation and the sensitivity decreased in relation to the content of DNA. (F.M.M.)

24484 REPAIR OF SOME KINDS OF DAMAGE INDUCED BY PHOTODYNAMICALLY ACTIVE DYES IN BACTERIOPHAGES OF E. COLI AND THE SENSIBILITY OF TEN STRAINS OF E. COLI TO THE PHOTODYNAMIC ACTION OF ACRIDINE ORANGE. Janovska, E.; Vizdalova, M.; Zhestyanikov, V. (Inst. of Biophysics, Brno. Inst. of Cytology, Leningrad). Sb. Ved. Pr. VLVDU Hradci Kralove; 55: 101-8(1970).

From All-Union Conference on Nuclear Medicine and Radiation Protection, Seci, Czechoslovakia. See CONF-700927.

The sensitivity of ten bacterial strains derived from Escherichia coli B and E. coli K_{12} with a different ability to repair uv- and x-radioinduced damage to the photodynamic action of acridine orange (AO) was studied. The inactivation of the strains after 1 hr incubation with AO in darkness and subsequent irradiation with visible light was investigated. No correlation was found between the sensitivity of the E. coli strains to the photodynamic action of AO and their ability to repair uv- or x-radioinduced damage. The survival of photodynamically inactivated T-phages was also investigated together with the possibility of repair of photodynamically induced damages. It was found that repair of these damages was not possible by the usual uv repair systems. The survival of the phages was related to the dose of visible light used. (F.M.M.)

Radiosterilization and Radiopreservation

Refer also to abstracts 23613 and 24317.

24485 (AECL-3653) THE USE OF NITROGEN DURING IRRADIATION TO IMPROVE COMPETITIVENESS IN STERILE MALES OF RHODNIUS PROLIXUS. Baldwin, W. F.; Chant, G. D. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Jun 1970. 6p. (CONF-700919-1; SM-138/1). Dep. NTIS (U. S. Sales Only). AECL $0.50.

From Symposium on the Sterility Principle for Insect Control or Eradication, Athens, Greece.

The control of insects by the sterile male method requires a high level of sterility in males; also, these males must be able to compete successfully with untreated individuals. Radiation exposures sufficient to produce sterility tend to reduce mating frequency and life span in irradiated males. A more favorable balance between these two effects was obtained by irradiating males of Rhodnius prolixus in nitrogen. In groups treated at three exposure levels (5, 10, and 15 kR) in air, the two higher exposures killed the insects or interfered with mating within the first 7 wk. Conversely, the insects exposed in nitrogen at these doses survived more than 15 wk and demonstrated continued mating activity over this period. Tests of competitiveness between irradiated and unirradiated groups, in which different ratios of sterile/normal males were tested with females, indicated that anoxia during irradiation produced a substantial improvement in competitiveness for a given degree of sterility. The results showed that the sterile insects could successfully lower egg hatch to less than 20% over 2 mon at 9:1 ratios and to less than 50% over the same period at 7:3 ratios of sterile to fertile males. (auth)

24486 (IAEA-R-440-F-31) THE EFFECTS OF IONIZING RADIATION ON MANGO, CHICO, AND BANANA FRUITS. Manalo, J. A.; Perez, R.; Silvestre, T.; (and others) (International Atomic Energy Agency, Vienna (Austria)). Dec 1969. 5p. NTIS (U. S. Sales Only).

Selected and assorted banana, mango, and chico fruits, respectively, were treated with various doses of gamma radiation. Irradiated fruits and controls were kept at constant temperature and tested at regular intervals during storage for moisture loss, texture, total solid content, pH, color, and organoleptic properties (by 10 trained judges in duo-trio tests). Mature green bananas irradiated at low doses and stored at 30°C ripened slower than the controls. Unirradiated mature-green bananas were nearly always preferred to irradiated ones. Greenish-orange bananas irradiated at 50 Krad were preferred to and always graded substantially higher than the controls. It was stated that once the ripening process has been started no delaying effect could be obtained, which indicates that the physiological stage of banana fruit is responsible for the possibility of ripening inhibition. A significant decay of all mangoes during storage was observed. Mangoes irradiated mature green and stored at 30°C exhibited a lower percentage of decay than the controls. Radiation did not have any pronounced effect on the shelf-life extension of chico fruits at 30°C as well as at 4°C. No significant differences in moisture, total solid content, pH (at 4°C), in appearance and aroma were observed between the controls and irradiated samples stored at 4°C and 30°C. Some changes in texture were noted, but no correlation between texture readings and incidence of decay could be stated. (auth) (INIS)

24487 (ORO-679) EFFECTS OF LOW-LEVEL IRRADIATION UPON THE PRESERVATION OF FOOD PRODUCTS. Annual Report, July 1, 1969-April 14, 1970. Ahmed, E. M.; Dennison, R. A. (Florida Univ., Gainesville. Dept. of Food Science). May 1970. Contract AT(40-1)-3097. 121p. Dep. NTIS.

Studies were done on the low dose effects of gamma irradiation on the preservation of food products. The results showed that navel oranges irradiated at 150 and 300 Krad showed greater CO_2 production and more O_2 consumption than that for the non-irradiated fruit; marsh seedless grapefruit irradiated at 300 Krad showed greater O_2 consumption than either the 150 Krad treated fruit or the non-irradiated fruit; irradiated as well as ripened Dixieland, Loring, Maygold, Redskin and Suwannee peaches, Tioga strawberries, and Floradel tomatoes were softer than the non-irradiated fruit or fruit at the firm ripe stage. Softness of the fruit was most pronounced immediately following irradiation but to lesser extent during storage. Softness due to ripening (storage at 68°F) proceeded at faster rates than softness due to irradiation; and irradiated as well as ripened peaches, strawberries, and tomatoes should be protected during handling, shipping and storage to a larger degree than the non-irradiated or firm-ripe fruit. (auth)

24488 (PRNC-143) INSECT STERILITY PROGRAM. Technical Report 5. Walker, David W. (Puerto Rico Nuclear Center, Rio Piedras). Feb 1971. Contract AT(40-1)-1833. 28p. Dep. NTIS.

A coordinated control program that combines the Inherited Partial Sterility System (IPS) with pheromone trapping lends itself well to a program of control for Diatraea saccharalis and other lepidoptera. The only apparent method for complete eradication is by sterile release induced by gamma irradiation. The major advantage of the sterile release method is that it becomes increasingly more effective as the natural population becomes smaller. Therefore, as conventional methods are losing their efficiency, sterile release is increasing in efficiency. The IPS method needs further study in order to determine the optimum dosage and management to assure dissemination of lethal factors (genetic load) throughout a natural population on an island while at the same time having the population later collapse or nearly collapse. (auth)

24489 (STI/PUB-196) PRESERVATION OF FISH BY IRRADIATION. Panel Proceedings Series. Proceedings of a Panel Held in Vienna, Austria, 15-19 December 1969. (International Atomic Energy Agency, Vienna (Austria)). Nov 1970. 169p. (CONF-691224). IAEA $5.00.

Ten articles are included; separate abstracts were prepared for each. (E.E.H.)

For abstracts of individual chapters see: 24496-24505.

24490 (STI/PUB-276) STERILE-MALE TECHNIQUE FOR CONTROL OF FRUIT FLIES. Panel Proceedings Series. Proceedings of a Panel on the Application of the Sterile-Male Technique for Control of Insects with Special Reference to Fruit Flies Held in Vienna, 1-5 September 1969. (International Atomic Energy Agency, Vienna (Austria)). Dec 1970. 185p. (CONF-690969). IAEA $5.00.

Nineteen articles are included; separate abstracts were pre-

pared for 12, including one summary of work done at various institutions on the Mediterranean fruit fly. The remaining seven articles contain information on: current mass-rearing techniques for the Mediterranean fruit fly; methods of mass rearing the Mediterranean fruit fly currently used by the U. S. Dept. of Agriculture; physiology of the Mediterranean fruit fly in relation to the sterile-male technique; new artificial oviposition device for the European cherry fruit fly; rearing experiments with the European cherry fruit fly; recommendations by the panel, and a summary of work done at various institutions on fruit flies other than the Mediterranean fruit fly. (E.E.H.)

For abstracts of individual papers see: 24506–24517.

24491 (TID–25544) STUDY OF IRRADIATED-PASTEURIZED FISHERY PRODUCTS. Final Report. Learson, R. J.; Schwartz, M. S.; Ronsivalli, L. J. (National Marine Fisheries Service, Gloucester, Mass. Gloucester Fisheries Products Technology Lab.). Oct 1970. Contract AT(49-11)-1889. 52p. Dep. NTIS.

A short summation of research from 1960 to 1968 is included and a detailed discussion of studies to establish the safety of irradiated fishery products is given. Maximum shelflife studies (X-values) designed to determine whether or not radiopasteurized samples spoil before botulism toxin can develop were carried out on cod and haddock fillets and the three species of Gulf shrimp. Odor panel evaluations were carried out using both expert and inexpert panels. (auth)

24492 (TID–25546) APPLICATION OF RADIATION-PASTEURIZATION PROCESSES TO PACIFIC COAST FISHERY PRODUCTS. Final Summary Report, October 1961–October 1969. Miyauchi, David (National Marine Fisheries Service, Seattle, Wash. Technology Lab.). Oct 1970. Contract AT(49-11)-2058. 24p. Dep. NTIS.

Progress is reported on storage life of irradiated fish; preference tests on radiation-pasteurized seafoods; effects of atmosphere in the package; effects of storage conditions on microflora of irradiated fish; treatment of fillets with sodium tripolyphosphate; microbial spoilage of irradiated fish; assessment of quality of irradiated fish; and irradiation of fish at sea. (H.L.W.)

24493 FOOD IRRADIATION. HYGIENICO-SANITARY ASPECTS. Lazzara, A. (Univ., Palermo, Italy). Ann. Sanita Pubblica; 30: 1005-24(Nov-Dec 1969). (In Italian).

After a brief review of the main effects of irradiation on the chemical composition and on the nutritional value of foodstuffs, the problem of safety of irradiated foodstuffs and the results of experimental researches that have been carried out until now, following the methodology already in use for chemical food additives are given. The hygienic aspects of the problem are also discussed in detail. (auth)

24494 FOOD IRRADIATION: A COMPLEX CONUNDRUM. Food Cosmet. Toxicol.; 7: 171-4(Mar 1969).

The points for and against radiopreservation of food products are discussed. The use of radiation for prevention of food spoilage is important in the developing countries. Reports are given on the effects of γ radiation on some foodstuffs. For example, a variation is seen in the susceptibility of fungi affecting melons. Radiation effects on the storage properties of crushed pineapple, on the lipid content of flour, and on the concentration of carbonyl compounds in clam meat are presented. Experiments were carried out to study the production of deoxy compounds from irradiated carbohydrates and the results are given. Finally, DNA reactions with irradiation products of carbohydrates were studied to assess the likelihood that irradiation of food will induce cell mutations in animals and plants in the food chain. It was reported that irradiated whole food and heterologous DNA appeared to be mutagenic in Drosophila. (F.M.M.)

24495 EFFECTS OF GAMMA IRRADIATION ON WASTE ACTIVATED SLUDGE. Baney, George Michael. Lafayette, Ind.; Purdue Univ. (1970). 142p. University Microfilms Order No. 71-2551.

Thesis.

The disinfecting effect of γ radiation at doses ranging from 50,000 to 1,000,000 rads at a dose rate of about 6000 rads/min on biological waste activated sludge was evaluated using the coliform and fecal streptococcal groups of microorganisms. The conditioning ability of irradiation for vacuum filtration was investigated using irradiation alone and in combination with ferric chloride and in combination with two organic monomers. Settleability studies were carried out in 1000-ml graduated cylinders, and the sedimentation rates of the sludges were recorded. The chemical oxygen demand and orthophoshate content of the supernatants were determined as was the sedimentation inducing effect of irradiated supernatant on nonirradiated sludge. Three 3-liter digesters were used to evaluate the anaerobic digestibility of irradiated sludge. During the experiment two of the digesters were fed sludge irradiated at 150,000 rads and one digester served as the control. The digesters were operated at various feed rates, 0.023 to 0.230 lb VS/cu ft/d, and various detention times, 6 to 15 d. Disinfection studies showed that the coliform and fecal streptococcal groups had differences in radiosensitivity. The initial coliform population was reduced by 99.99% by a dose of 150,000 rads and the initial fecal streptococci population was reduced by 95%. Irradiation alone only slightly improved the filterability of sludge. When used in combination with ferric chloride, irradiation produced an increase in the solids concentration of the filter cake but also increased the time necessary to dewater the cake. The addition of acrylonitrile and methyl methacrylate to the sludge caused the sludge to congeal upon irradiation. Sedimentation experiments showed that a radiation dose of 50,000 rads generally increased the average settleability of the sludge by a factor of 1.9 over the control samples at the end of a 90-min period. Irradiation caused the chemical oxygen demand and orthophosphate content of the supernatants from settleability tests to increase at a rate proportional to the radiation dose. At a dose of 600,000 rads the average chemical oxygen demand increase was 435 ± 75 mg/l; the average orthophosphate increase was 13.7 ± 4.1 mg/l. Experimentation showed that supernatant from irradiated sludge could cause increased sedimentation of non-irradiated sludge. Digestion studies showed that the pH, alkalinity, volatile acids concentration, rate of gas production, and evolved gas composition did not vary significantly among the three digesters during the period of experimentation. (Diss. Abstr. Int., B)

24496 STUDIES IN PETITION-ORIENTED ASPECTS OF RADIATION PASTEURIZATION OF FISHERY PRODUCTS. Ronsivalli, L. J.; Kaylor, J. D.; Murphy, E. J.; Learson, R. J.; Schwartz, M. S. (Bureau of Commercial Fisheries, Gloucester, Mass.). pp 1-11 of Preservation of Fish by Irradiation. Vienna; International Atomic Energy Agency (1970).

From Panel on Preservation of Fish by Irradiation, Vienna, Austria. See STI/PUB–196; CONF-691224.

Following the many successful experiments substantiating the feasibility of preserving fishery products with γ rays, there remains the task of obtaining approval from the U. S. Food and Drug Administration before the process can be used in commerce. The Gloucester Technological Laboratory has conducted research in two pertinent areas. In one study, an empirical test was used to collect data in one aspect of a multi-laboratory investigation of a possible botulism hazard in radiation pasteurized fishery products. In the second study, the efficacy of the process was substantiated under commercial shipping conditions. (auth)

24497 EFFECT OF GAMMA IRRADIATION ON THE MICROBIAL SPOILAGE PATTERNS ON FISH, IN RELATION TO INITIAL QUALITY. Laycock, A.; Regier, I. W. (Fisheries Research Board of Canada, Halifax, Nova Scotia). pp 13-25 of Preservation of Fish by Irradiation. Vienna; International Atomic Energy Agency (1970).

From Panel on Preservation of Fish by Irradiation, Vienna, Austria. See STI/PUB–196; CONF-691224.

The effects of age of fish prior to irradiation (100 krad) on the post-irradiation storage life and bacterial flora of aerobically stored haddock fillets were investigated. Significant extensions in storage life were found after irradiation, even for fish judged to be of fairly low quality initially. However, fillets from older (low quality) fish were found to be borderline in quality for most of their extended storage life, while fillets from fresh fish were borderline in quality only during the latter half of their extended storage life. Although bacterial numbers were initially lower on irradiated fish, 2-day and 5-day irradiated fish had 10 to 100 times as many bacteria as their unirradiated counterparts at spoilage. Initial quality did not appear to affect, qualitatively, the flora developing during storage on unirradiated fillets on which pseudomonads and Achromobacter predominated. However, on irradiated fillets, while Achromobacter predominated, a change in the character of the Achromobacter isolates from 2-day and 5-day irradiated fish was observed at spoilage. (auth)

24498 PROLONGING THE COMMERCIAL LIFE OF FRESH WHITE (LEAN) FISH: MICROBIOLOGICAL ASPECTS. de la Sierra Serrano, D. (Dept. of Chemistry and Isotopes, Madrid). pp 27-48 of Preservation of Fish by Irradiation. Vienna; International Atomic Energy Agency (1970).

From Panel on Preservation of Fish by Irradiation, Vienna, Austria. See STI/PUB–196; CONF-691224.

A series of experiments are presented on the irradiation of fresh white (lean) fish of the species Merluccius merluccius, in which the dose applied ranged between 50 and 300 krad and the irradiation conditions, i.e., packaging in different materials, temperature and atmosphere, were varied. The microbiological studies were concentrated on the evolution of residual microbial flora

as a function of the parameters considered. The results obtained are discussed with a view to evaluating their significance from the commercial and health standpoints. It was concluded that under suitable conditions, with storage temperatures from 0 to 3°C and low initial contamination levels, it is possible to secure a commercially worth-while prolongation of the storage life of hake fillets amounting to 10 to 12 days, by the application of doses of 50 and 100 krad. Larger doses were required for higher initial contamination indices and also whenever gas-permeable wrapping materials were used. It will be necessary, however, to make further tests to confirm the conclusions, and in so doing to broaden and improve various aspects and areas of the scheduled research. (auth)

24499 REPORT ON A SURVEY PROJECT IN ICELAND ON THE USE OF RADIATION PASTEURIZATION OF VARIOUS SEAFOODS. Hannesson, G.; Dagbjartsson, B. (Icelandic Fisheries Labs., Reykjavik). pp 49-64 of Preservation of Fish by Irradiation. Vienna; International Atomic Energy Agency (1970).

From Panel on Preservation of Fish by Irradiation, Vienna, Austria. See STI/PUB-196; CONF-691224.

A survey project on the irradiation preservation of seafoods, sponsored by the Government of Iceland, the International Atomic Energy Agency and the United States Atomic Energy Commission has been carried out at the Icelandic Fisheries Laboratories. A summary of results obtained on Norway lobster tails, deep-sea shrimp, and cod fish is given. (auth)

24500 RADURIZATION OF FRESH-WATER FISH IN THE FEDERAL REPUBLIC OF GERMANY. Ehlermann, D.; Muenzner, R. (Inst. of Radiation Tech., Karlsruhe, Ger.). pp 65-74 of Preservation of Fish by Irradiation. Vienna; International Atomic Energy Agency (1970).

From Panel on Preservation of Fish by Irradiation, Vienna, Austria. See STI/PUB-196; CONF-691224.

Fresh gwyniad, trout, and carp were vacuum-packed in plastic foil impermeable to gas and water vapor, irradiated with 10-MeV electrons, and stored under melting ice. Sensory, chemical, and microbiological tests were then carried out over a period of four to two weeks. In the case of gwyniad, best results were obtained with a dose of 0.1 Mrad which prolonged Grade-1 quality shelf life from nine to 23 days. With trout a dose of 0.05 Mrad improved the shelf life from 15 to 21 days. Doses higher than 0.1 Mrad for gwyniad and 0.05 Mrad for trout caused a noticeable loss of flavor. In this respect trout appeared to be particularly radiosensitive in comparison with other species of fish. In contrast, carp turned out to be particularly well suited for radiopreservation treatments, as its flavor was not negatively affected even by relatively high radiation doses. While unirradiated carp could be stored for 15 days, a dose of 0.5 Mrad preserved the Grade-1 quality shelf life for 35 days. Higher doses, up to 1.5 Mrad, caused a further reduction of microbial counts improving the shelf life beyond the results obtained with 0.5 Mrad. The latter dose, which did not affect flavor, was therefore considered for carp. (auth)

24501 PRESERVATION BY GAMMA RADIATION OF BOMBAY DUCK, SHRIMPS, AND WHITE POMFRETS. Kumta, U. S.; Sreenivasan, A. (Bhabha Atomic Research Centre, Trombay, India). pp 75-104 of Preservation of Fish by Irradiation. Vienna; International Atomic Energy Agency (1970).

From Panel on Preservation of Fish by Irradiation, Vienna, Austria. See STI/PUB-196; CONF-691224.

Radiation-processing procedures have been developed for extending storage shelf life at sub-room as well as room temperatures for Bombay duck (Harpodon nehereus), shrimps (Metapenaeus sp. and Parapeneopsis stylifera), and white pomfrets (Stromateus cinereus). The physical, chemical, and microbiological changes in each of these seafoods have been evaluated critically to establish the technological merits of the processes. Studies on the radiation sensitivity and biochemical properties of fish microflora provided evidence for the selective control of rapid spoilers in irradiated Bombay duck. The biochemically inert nature of Micrococcus sp. predominant in radiation-pasteurized Bombay duck concurrent with the suppression of Gram-negative spoilers, brought about a high acceptability of irradiated products during storage. Irradiation at 0.1 Mrad extended the storage life of Bombay duck for 18 to 20 days at 0 to 2°C due to a lower spoilage rate as against the rapid deterioration of unirradiated samples within 5 to 7 days. Textural losses due to exudation of drip in irradiated as well as in unirradiated Bombay duck were minimized by pre-dip treatments in 10% NaCl for 60 min or in 10% sodium tripolyphosphate for 15 minutes. Fresh Bombay-duck fillets or laminates were preserved by a radiation dose of 0.25 Mrad for three weeks at 0 to 2°C and partially dried laminates for three months at 28 to 32°C. Insect damage to air-dried or commercially sun-dried Bombay-duck laminates was prevented by 15 krads. The tolerance dose in the range 0.15 to 0.25 Mrad for shrimps has been selected on the basis of retaining the naturally occurring pigment and the absence of irradiation odors. The radiation-pasteurization process for fresh and blanched shrimps (100°C, 4 min) extended the shelf life by 18 and 130 days respectively at 0 to 2°C. Cooked and semi-dried shrimps were stabilized for room-temperature storage for 3 and 6 months, respectively. The development of rancid odors and yellow discoloration during the storage of irradiated pomfret (above 0.3 Mrad) was effectively minimized by maintaining anaerobic conditions during irradiation and storage. The radiation-pasteurization process for white pomfret fillets consisted of anaerobic packaging and irradiation (0.1 Mrad). This treatment augmented the shelf life of pomfrets by 35 days at 0 to 2°C as against the spoilage of unirradiated products within 7 days. Transportation studies of irradiated Bombay duck, eel, and shrimps showed prospects for radiation-pasteurization processing in the inland distribution of fishery products. (auth)

24502 USE OF LOW DOSES OF GAMMA RADIATION FOR THE PRESERVATION OF WHITE FISH FILLETS. Matutano Aranda, J. I.; Alonso Rodriguez, M. (Dept. of Chemistry and Isotopes, Madrid). pp 105-15 of Preservation of Fish by Irradiation. Vienna; International Atomic Energy Agency (1970).

From Panel on Preservation of Fish by Irradiation, Vienna, Austria. See STI/PUB-196; CONF-691224.

Hake fillets packed in plastic bags, permeable and impermeable to gas, in a normal atmosphere and under vacuum were irradiated at 100, 150, and 200 krads with subsequent storage at refrigeration temperatures (1°C). Periodic biochemical checks were carried out on the level of decomposition and sensory assessments made on the quality of raw and cooked fillets, using untrained tasting panels consisting of 20 and 10 judges, respectively. The results are discussed and the conclusions given. (auth)

24503 BOTULISM HAZARD IN THE PROPOSED USE OF IRRADIATION OF FISH AND FISHERY PRODUCTS IN THE UNITED KINGDOM. Shewan, J. M.; Hobbs, G. (Ministry of Tech., Aberdeen, Eng.). pp 117-24 of Preservation of Fish by Irradiation. Vienna; International Atomic Energy Agency (1970).

From Panel on Preservation of Fish by Irradiation, Vienna, Austria. See STI/PUB-196; CONF-691224.

Proposals to treat packaged fish with pasteurizing doses of radiation, and the potential health hazards of this process is described. Proposals are made to introduce irradiation into an existing processing and distribution chain for retail packs of chilled fish. The Codes of Practice in use at present provide an adequate safeguard against possible health hazards, primarily by the control of temperature, and limit the storage time to about half the potential shelf life of the fish. Irradiation of these products with 0.3 Mrad will result in a considerable extension of storage life while maintaing the same high quality of the product. It was concluded that while Clostridium botulinum types E, F, and non-proteolytic B could be present in the raw material, no particular health hazard exists unless gross malpractice occurs, especially in relation to the temperature of storage. (auth)

24504 SIGNIFICANCE OF NON-PROTEOLYTIC CLOSTRIDIUM BOTULINUM TYPES B, E, AND F IN THE DEVELOPMENT OF RADIATION PASTEURIZED FISHERY PRODUCTS. Eklund, M. W.; Poysky, F. T. (Bureau of Commercial Fisheries, Seattle). pp 125-48 of Preservation of Fish by Irradiation. Vienna; International Atomic Energy Agency (1970).

From Panel on Preservation of Fish by Irradiation, Vienna, Austria. See STI/PUB-196; CONF-691224.

The outgrowth and toxin production of Clostridium botulinum type E has been studied in unirradiated and irradiated Atlantic Coast haddock and cod and Pacific Coast English, petrale, and Dover sole fillets stored in the temperature range of 38 to 50°F (3.3 to 10°C). Data collected thus far suggest that irradiated haddock would not provide any more of a health hazard than unirradiated haddock provided the product could be distributed and stored at 42°F (5.6°C) or below. At 46°F (7.8°C) storage, the inoculated pack results with 100-krad irradiation appeared favorable, since there was considerable safety margin between maximum storage life and earliest toxin production by type E. The samples irradiated at 200 krads appeared less favorable because of the longer storage life and earlier toxin development of toxin in samples inoculated with 10^4 spores/g. At 50°F (10°C) storage, a safety margin did not exist between maximum storage and toxin production for either the unirradiated or irradiated samples. Irradiated petrale, English, and Dover sole (from the Pacific Coast of the United States) were better substrates for Cl. botulinum than either haddock fillet. Outgrowth and toxin production occurred in the irradiated sole species vacuum-packaged, but not in samples packaged in oxygen-permeable films stored at 42°F (5.6°C). It was conjectured that the ribose and glucose contents of the fish fillets

are important factors which account for the differences in the rates of toxin production in different species of fish and in English sole fillets packaged in oxygen-permeable or -impermeable films. Non-proteolytic Cl. botulinum types B and F, isolated from marine sediments, shared the same physiological and biochemical characteristics possessed by type E. These cultures all grew at refrigerated temperatures as low at 38°F (3.3°C) and produced toxin. Bacteriophages have been observed in electron micrographs of the lysates of the different types of Cl. botulinum. Bacteriophages of non-proteolytic types B and F and proteolytic type F have been propagated and a study of the relationship of these phages to the toxigenesis of Cl. botulinum is currently in progress. (auth)

24505 DOSIMETRY AS A FACTOR IN ASSESSING THE TECHNICAL EFFECTS OF IRRADIATION ON FOOD PRODUCTS. Leone, F. A. (Atomic Energy Commission, Washington, D. C.). pp 149-55 of Preservation of Fish by Irradiation. Vienna; International Atomic Energy Agency (1970).

From Panel on Preservation of Fish by Irradiation, Vienna, Austria. See STI/PUB-196; CONF-691224.

The importance and need of universal uniform methods of measuring and reporting absorbed doses as related to the interpretation of irradiation effects on food items are discussed. The need and importance for uniformity of dose in the interpretation of microbiological and organoleptic studies of fishery products are specifically discussed using limited actual data as well as an illustrative example. (auth)

24506 STERILIZATION OF THE MEDITERRANEAN FRUIT FLY. A REVIEW OF LABORATORY DATA. Hooper, G. H. S. (International Atomic Energy Agency, Vienna). pp 3-12 of Sterile-Male Technique for Control of Fruit Flies. Vienna; International Atomic Energy Agency (1970).

From Panel on the Application of the Sterile-Male Technique for Control of Insects with Special Reference to Fruit Flies, Vienna, Austria. See STI/PUB-276; CONF-690969.

The current status of research on the sterilization of the Mediterranean fruit fly, Ceratitis capitata, is reviewed. Adult emergence and survival are discussed in terms of pupal stage at time of irradiation, effects of dose, and deprivation of food and water to irradiated flies. The effects of female sensitivity to γ radiation in comparison with the male and the reasons for this were noted. The effects of irradiation on mating characteristics, especially female polygamy and male competitiveness, and the need for more work in this area are discussed. Dosage characteristics, neutron irradiation, and chemosterilization are also mentioned briefly. (E.E.H.)

24507 RECENT RESEARCH IN HAWAII ON THE MEDITERRANEAN FRUIT FLY. Chambers, D. L.; Ohinata, K.; Cunningham, R. T. (Dept. of Agriculture, Honolulu, Hawaii). pp 33-42 of Sterile-Male Technique for Control of Fruit Flies. Vienna; International Atomic Energy Agency (1970).

From Panel on the Application of the Sterile-Male Technique for Control of Insects with Special Reference to Fruit Flies, Vienna, Austria. See STI/PUB-276; CONF-690969.

The feasibility of the sterile-insect technique as a method of suppression or eradication has been demonstrated for several fruit fly species. However, the competitiveness of the sterile insect is apparently less than that of its native counterparts. Current research at the Hawaiian Fruit Flies Investigations Laboratory is directed towards understanding the effects of the sterile-insect technique on this insect in order to improve the methods of application. Different types of methods of evaluation, improvement in feeding larvae and adults, and effects of radiation, packing, marking, and release, on the fly are discussed. (auth)

24508 APPLICATION OF THE STERILE-MALE TECHNIQUE IN MEDITERRANEAN FRUIT FLY SUPPRESSION. A FOLLOW-UP EXPERIMENT IN NICARAGUA. Rhode, R. H. pp 43-50 of Sterile-Male Technique for Control of Fruit Flies. Vienna; International Atomic Energy Agency (1970).

From Panel on the Application of the Sterile-Male Technique for Control of Insects with Special Reference to Fruit Flies, Vienna, Austria. See STI/PUB-276; CONF-690969.

A follow-up experiment designed to demonstrate Mediterranean fruit fly suppression in a 48-km^2 area in the region of Carazo, Nicaragua, is discussed. This release area was surrounded by a 2-km wide band which received several chemical treatments by applying a 9:1 mixture of protein hydrolysate and technical malathion. Also, two check areas were included. Flies, sterilized with γ radiation, were released by plane about 4 days a week, approximately 11 million flies per flight. Results indicated a clear suppression of the Mediterranean fruit fly when comparing the number of wild flies, fruit infestation, and percentage egg hatch in the release area with the check area. (auth)

24509 PRE-RELEASE PHASE OF THE 1969 MEDITERRANEAN FRUIT FLY SUPPRESSION EXPERIMENT IN ITALY. Hooper, G. H. S.; Nadel, D. J. (International Atomic Energy Agency, Vienna). pp 51-8 of Sterile-Male Technique for Control of Fruit Flies. Vienna; International Atomic Energy Agency (1970).

From Panel on the Application of the Sterile-Male Technique for Control of Insects with Special Reference to Fruit Flies, Vienna, Austria. See STI/PUB-276; CONF-690969.

The various steps involved in the production, ^{60}Co γ sterilization, and shipment of sterile Ceratitis capitata (Wiedemann) for the 1969 suppression experiment on the island of Procida, Italy, are described. The results of tests, carried out on each shipment of pupae, to evaluate adult emergence and sterility are reported. (auth)

24510 EXPERIMENT TO CONTROL THE MEDITERRANEAN FRUIT FLY ON THE ISLAND OF PROCIDA BY THE STERILE-INSECT TECHNIQUE. de Murtas, I. D. (Comitato Nazionale per l'Energia Nucleare, Rome); Cirio, U.; Guerrieri, G.; Enkerlin S., D. pp 59-70 of Sterile-Male Technique for Control of Fruit Flies. Vienna; International Atomic Energy Agency (1970).

From Panel on the Application of the Sterile-Male Technique for Control of Insects with Special Reference to Fruit Flies, Vienna, Austria. See STI/PUB-276; CONF-690969.

During 1969 an experiment to evaluate the sterile-insect technique using ^{60}Co γ radiation as a method of control for the Mediterranean fruit fly, Ceratitis capitata (Wiedemann), was conducted on the island of Procida. Although releases were initiated rather late (16 May) and with fewer flies than originally planned, adequate protection of most of the commercial peaches and apricots was achieved. In the release area, a number of fruits showed punctures without eggs. These were considered as mechanical damage done by released sterile females but the economic importance of such punctures could not be determined. Observations indicated that at least part of the Mediterranean fruit fly population overwinters in sour orange varieties. These fruits should be picked during the winter and destroyed, thus at least reducing the new population in the spring. (auth)

24511 SOME OBSERVATIONS ON DECREASED VITALITY OF IRRADIATED MEDITERRANEAN FRUIT FLY. Haisch, A. (Bayerische Landesanstalt fuer Bodenkultur, Munich). pp 71-5 of Sterile-Male Technique for Control of Fruit Flies. Vienna; International Atomic Energy Agency (1970).

From Panel on the Application of the Sterile-Male Technique for Control of Insects with Special Reference to Fruit Flies, Vienna, Austria. See STI/PUB-276; CONF-690969.

It was found that ^{137}Co γ irradiation of Ceratitis capitata (Wiedemann) must affect the functions of the digestive apparatus and of the male genital organs. On the whole the competitiveness of irradiated males compared with unirradiated ones was clearly reduced. (auth)

24512 RELEASING SEXUALLY-STERILIZED MEDITERRANEAN FRUIT FLIES FOR CONTROLLING THE INSECT IN NORTH AFRICA. POSSIBILITIES OF USE AND PROBLEMS INVOLVED. Harris, E. J. (American Embassy, Tunis). pp 77-80 of Sterile-Male Technique for Control of Fruit Flies. Vienna; International Atomic Energy Agency (1970).

From Panel on the Application of the Sterile-Male Technique for Control of Insects with Special Reference to Fruit Flies, Vienna, Austria. See STI/PUB-276; CONF-690969.

The preparations, plans, and possible approaches in the work aimed at control of Ceratitis capitata (Wiedemann) in Tunisia and Morocco are discussed. (auth)

24513 MEDITERRANEAN FRUIT FLY: SHORT CONTRIBUTIONS. SUMMARIES OF WORK DONE AT VARIOUS INSTITUTIONS. pp 81-95 of Sterile-Male Technique for Control of Fruit Flies. Vienna; International Atomic Energy Agency (1970).

From Panel on the Application of the Sterile-Male Technique for Control of Insects with Special Reference to Fruit Flies, Vienna, Austria. See STI/PUB-276; CONF-690969.

Short contributions of the work done at various institutions in relation to control or eradication of the Mediterranean fruit fly are summarized. These include a study of the effects of γ radiation on the sexual vigor of Ceratitis capitata, a report on the sterile-fly release experiment in Nicaragua, a note on work done at Ispra, Italy, research presently being conducted in Ariana, Tunisia, a report on the fruit fly suppression experiment on the Spanish mainland at Alhama de Murcia, and recent research on sterilization of Ceratitis capitata. Also included is a report on recent work on the physiology of the Mediterranean fruit fly. (E.E.H.)

24514 STERILE-INSECT TECHNIQUE FOR ERADICATION OR CONTROL OF THE MELON FLY AND ORIENTAL FRUIT FLY. REVIEW OF CURRENT STATUS. Chambers, D. L.; Spencer, N. R.; Tanaka, N.; Cunningham, R. T. (Dept. of Agriculture, Honolulu, Hawaii). pp 99-109 of Sterile-Male Technique for Control of Fruit Flies. Vienna; International Atomic Energy Agency (1970).

From Panel on the Application of the Sterile-Male Technique for Control of Insects with Special Reference to Fruit Flies, Vienna, Austria. See STI/PUB-276; CONF-690969.

A summary was presented of the programs conducted in the Mariana Islands to develop a method for insect control by releasing ^{60}Co γ-irradiated sterile insects by the Hawaiian Fruit Flies Investigations, Agricultural Research Service. Control and eradication of the melon fly and oriental fruit fly has been achieved, and successful completion of a current program of eradication of the melon fly from Guam will free the Mariana Islands of pest tephritids. (auth)

24515 STERILE-MALE TECHNIQUE FOR ERADICATION OF THE MEXICAN AND CARIBBEAN FRUIT FLIES. REVIEW OF CURRENT STATUS. Lopez D., Fernando (Dept. of Agriculture, Miami, Fla.). pp 111-17 of Sterile-Male Technique for Control of Fruit Flies. Vienna; International Atomic Energy Agency (1970).

From Panel on the Application of the Sterile-Male Technique for Control of Insects with Special Reference to Fruit Flies, Vienna, Austria. See STI/PUB-276; CONF-690969.

Research at the Mexican Fruit Fly Investigations laboratory in Mexico City, Mexico, with the Mexican fruit fly Anastrepha ludens (Loew) demonstrated that this fly could be artificially reared in a carrot-base medium and sterilized with 5000 Rad. Adult flies could also be sterilized by dipping them as pupae in a 5% solution of tepa in water. Field fly releases with either sterilization method demonstrated that the sterile-fly release method is useful for control purposes or possible eradication if the infested area can be overflooded with sterile flies. Studies on the Caribbean fruit fly Anastrepha suspensa (Loew) carried out in Miami, Florida, since 1968 are giving encouraging results for the application of the sterile-male technique. Flies are being reared in several types of media, although at present the hatch rate and larval recoveries are low. Gamma radiation doses required to sterilize this fly are in the range of 5000 to 6000 Rad. (auth)

24516 STERILE-MALE TECHNIQUE FOR CONTROL OF THE OLIVE FLY. REVIEW OF WORK ON REARING AND RADIATION. de Magalhaes Silva, G. (Estracao Agronomica Nacional, Oeiras, Portugal). pp 119-30 of Sterile-Male Technique for Control of Fruit Flies. Vienna; International Atomic Energy Agency (1970).

From Panel on the Application of the Sterile-Male Technique for Control of Insects with Special Reference to Fruit Flies, Vienna, Austria. See STI/PUB-276; CONF-690969.

All aspects of rearing Dacus oleae (Gmelin) are reviewed. Results indicated that the composition of the diet is quite satisfactory and that the main problems are adequate egg-laying devices as well as reduction in rearing space. Work on ^{60}Co γ radiation and chemical sterilization is mentioned. Larvae, pupae, and adults were sterilized. As expected, a higher dose was needed for the more advanced phase. Triethylenephosphoramide (Tepa) seemed to be the most promising of the various chemosterilants tested. (auth)

24517 REVIEW OF OLIVE-FLY ECOLOGY IN RELATION TO THE STERILE-MALE TECHNIQUE. Mourikis, P. A.; Fytizas, E. (Benaki Phytopathological Inst., Athens). pp 131-9 of Sterile-Male Technique for Control of Fruit Flies. Vienna; International Atomic Energy Agency (1970).

From Panel on the Application of the Sterile-Male Technique for Control of Insects with Special Reference to Fruit Flies, Vienna, Austria. See STI/PUB-276; CONF-690969.

Data on average monthly catches of Dacus oleae (Gmelin) are presented for the years 1966 and 1967 as compared with mean temperature and relative humidity. In both years the population peak was in October and four generations were found. Laboratory experiments indicate that adults must be present in olive groves even during the colder part of the year. Results of γ radioinduced male sterility research are discussed. The need is mentioned of a powerful attractant in order to determine population levels in olive groves, longevity and field behavior of released sterile flies, and migrations from one group of orchards to the other ones. Work with chemosterilants, namely triethylenephosphoramide (Tepa), is reviewed. (auth)

24518 DEISTVIE GAMMA-IZLUCHENIYA NA BEZALKOGOL'NYE NAPITKI I VINNO-KON'YACHNYE IZDELIYA. (Gamma Radiation Effects on Alcohol-Free Beverages and on Wine-Cognac Products). Bregvadze, U. D. Moscow; Izdatel'stvo Pishchevaya Promyshlennost (1970). 132p.

The effects of γ radiation are described for the treatment of food products. The radiation apparatus used is described. Irradiation was used for the purpose of improving the quality of fruit juices, semi sweet wines, mineral drinking water, coagulants, and cognac. The book is designed for use by scientific and technical engineers in the food industry. The bibliography contains 263 citations. (tr-auth)

24519 CONSERVATION OF FOOD OF ANIMAL ORIGIN BY IRRADIATION. Diehl, J. F. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Zentralbl. Veterinaermed., Beih.: No. 11, 206-21(1970). (In German).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

The use of small doses of radiation to prolong storage time or to inhibit pathogens offers considerable promise for a number of products. The irradiation of potatoes with a relatively small dose to prevent sprouting is used in a number of countries and has been shown to be harmless in animal experiments. Good results are obtained in biochemical studies on irradiation of fish to prolong storage time. Further work on larger doses should make possible the widespread use of irradiated foodstuffs. (auth)

24520 USE OF IONIZING RADIATIONS TO INCREASE THE STORAGE TIME OF PRE-PACKED BEEFSTEAKS. Klima, D.; Petricek, M. (Fleischwirtschaft, Brno). Zentralbl. Veterinaermed., Beih.: No. 11, 222-6(1970). (In German).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

A dose of 500 kRads of ^{60}Co γ radiation was effective in lengthening storage time of prepacked ox meat by up to 10 days at a temperature of 5 to 6°C without deterioration. On the other hand this dose produced recognizable organoleptic and side effects, such as changes in color, consistence, flavor, and odor. In addition to these organoleptic changes there was evidence of damage caused by enzymatic changes that have serious effects on the technological properties of the meat. (auth)

24521 SOME ORGANOLEPTIC, CHEMICAL, AND MICROBIOLOGICAL ASPECTS OF IRRADIATED PORTUGUESE SAUSAGES. Simoes, J. Henriques; d'Abreu, F. M. Marques; Martins, A. A. R. Lopes; Ferreira, C. A. Goncalves (Estacao de Estudos de Tecnologia Animal, Oeiras, Portugal). Zentralbl. Veterinaermed., Beih.: No. 11, 227-38(1970).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

Samples of a typical smoked sausage, canned in different atmospheres, were irradiated with doses from 0.64 to 2 MRads of x radiation and then stored under different conditions. Although the total bacterial content was reduced, no shelf-life increase was noted and no significant organoleptic and chemical changes were observed. An inhibiting effect on the further growth of surviving bacteria was observed. (auth)

24522 STORAGE OF IRRADIATED POTATOES. Penner, Hans (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Ind. Obst- Gemueseverwert.; 55: 58-61(1970). (In German).

At the Federal Research Institute for Preservation of Foodstuff, 2.4 tons of potatoes were exposed to 8 to 14 krad of ^{60}Co γ radiation. Weight loss during storage was studied. Results showed that in irradiated potatoes the weight loss was about 2 to 3% less than in non-irradiated controls. Economic aspects of storage and preservation were compared for cooling, chemical treatment, and irradiation. Thus far, the West German government has not licensed the sale of irradiated potatoes. (H.B.G.)

24523 EFFECTS OF ELECTRON RADIATION ON THE CONSISTENCY OF THE EXOCARP OF CHERRIES. Penner, Hans (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Ind. Obst- Gemueseverwert.; 55: 163-6 (1970). (In German).

The consistency of the exocarp of cherries was measured with a Wolodkewitsch apparatus, and comparison was made between the effects of ionizing radiation, storage time, and calcium chloride treatment on consistency. Radiation decreased consistency, while calcium chloride treatment and storage resulted in an increase. (tr-auth)

24524 HARMLESS RADIOPRESERVATION OF FOODS. Diehl, J.-F. (Bundesforschungsanstalt fuer Lebensmittelfris-

XUM

chhaltung, Karlsruhe, Ger.). Umsch. Wiss. Tech.; No. 1, 8-11 (1970). (In German).

Radiopreservation of foodstuffs is reviewed. Discussed are: technological and economical significance, health problems, experimental feeding studies in animals, physical and chemical investigations, microbiological studies, and authorization procedures. (H.B.G.)

24525 RADIATION PRESERVATION OF FISH PRODUCTS: A CONVENIENT MEAL OF COD. Ehlermann, D.; Muenzner, R. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Kaeltetech.-Klim.; 21: 331-2(1969). (In German).

Under oxygen exclusion, cod patties were packed in foils that were gas- and steamtight. Subsequently they were irradiated with 10-MeV electrons and stored in melting ice. Throughout a period of four to six weeks, chemical and microbiological studies were performed. Results showed that nonirradiated cod patties had a shelf life of seven days. Doses from 100 to 300 krad improved the shelf life to 12 or 21 days, respectively. Thus, 300 krad tripled the shelf life and appeared promising for industrial application. (tr-auth)

24526 INVESTIGATIONS CONCERNING THE INFLUENCE OF TEMPERATURE ON IRRADIATION LOSSES OF CYSTINE AND CYSTEINE IN FOODSTUFFS. Gruenewald, Th. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Kaeltetech.-Klim.; 21: 336-8(1969). (In German).

In freeze-dried pork as well as fresh and freeze-dried beef, cystine and cysteine content were determined polarographically. Irradiation with less than 1 Mrad failed to induce significant changes. Five Mrad reduced the cysteine content, partially through transformation into cystine. In fresh beef, conversely to freeze-dried samples, cysteine loss could be prevented by irradiation at cryogenic temperatures. (tr-auth)

24527 INFLUENCE OF RADIATION ON SOME PHYSIOLOGICAL BACTERIAL GROUPS IN COLD STORED TROUT. Muenzner, R. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Kaeltetech.-Klim.; 21: 328-30 (1969). (In German).

Trout with four different degrees of bacterial contamination were packaged under vacuum and irradiated with 0.1 Mrad. Throughout cold storage of irradiated and nonirradiated fish, the germ count was determined at 4, 20, 29, and 37°C incubation temperature. Gelatin-liquifying and casein-degrading germs were counted separately. Results showed that radiation treatment reduced predominantly proteolytic germs, while psychrotrophic germs were affected to a lesser degree. (tr-auth)

24528 RESPIRATION OF A BLACK SPRUCE HUMUS STERILIZED BY HEAT OR IRRADIATION. Roberge, M. R. (Dept. of Fisheries and Forestry, Sainte Foy, Quebec). Soil Sci.; 111: 124-8(Feb 1971).

Manometric studies were carried out on samples of the surface organic humus from a Quebec black spruce (Picea mariana) stand. Steam and ^{60}Co were used as sterilizing agents. Both sterilizing agents did not prevent O_2 uptake. The addition of urea and NaN_3 did not change the O_2 uptake to autoclaved samples. However, the addition of urea slightly increased the O_2 uptake of irradiated samples, and the addition of NaN_3 decreased it markedly. Irradiation very slightly increased the O_2 uptake of steam-sterilized samples and markedly decreased that of radiosterilized samples. It is concluded that respiratory enzymes were responsible for most of the oxygen uptake in gamma-sterilized samples of soil organic matter. (auth)

24529 PESTICIDAL RESIDUE ALTERATIONS IN POTATOES DURING PROCESSING. Solar, James Michael. Baton Rouge, La.; Louisiana State Univ. (1970). 82p. University Microfilms Order No. 71-3444.

Thesis.

Irish and sweet potatoes were spiked with 100 ppM endrin. One-half of the samples were irradiated and all were processed with one of four processing methods (heat processing, with and without water and frozen, blanched and unblanched). Samples were stored 0, 6, and 12 weeks. Analysis detected three pesticidal residues: aldrin, heptachlor epoxide, and endrin. In the control, heptachlor epoxide was significantly greater in Irish potatoes; aldrin was significantly greater in sweet potatoes. There was no difference in the endrin content. There was a significant decrease of aldrin and heptachlor epoxide with irradiation of the control; endrin was not affected. Aldrin residues were the only ones of the three to be significantly decreased with storage. Irradiation of processed potatoes did not significantly decrease the quantities of any of the pesticidal residues in the samples. Processing significantly decreased all of the pesticidal residues. Endrin residues were significantly decreased with heat processing. Endrin was also decreased with a combination of blanching and freezing. Aldrin was altered primarily with blanching and freezing and to a lesser extent by heat processing without water. Heptachlor epoxide was equally affected by each of the processing methods. (Diss. Abstr. Int., B)

24530 EFFECTS OF RADIATION PASTEURIZATION ON SALMONELLA. III. RADIATION LETHALITY AND THE FREQUENCY OF MUTATION TO ANTIBIOTIC RESISTANCE. Previte, J. J.; Chang, Y.; El-Bisi, H. M. (Army Natick Labs., Mass.). Can. J. Microbiol.; 17: 385-9(Mar 1971).

The radiation resistance (D, in megarads) of six strains of Salmonella irradiated at 4C in brain heart infusion suspension ranged from 0.042 for S. enteritidis to 0.084 for S. thompson. The resistance values were 0.048 for S. typhimurium, strain SR-11, 0.060 for S. typhimurium, strain RIA, and S. newport, and 0.078 for S. heidelberg. The mutation frequency to tetracycline resistance of S. typhimurium, strain SR-11, increased between 0 and 0.05 Mrad and declined thereafter with increasing radiation dose. After 0.5-Mrad exposure, the mutation frequency was essentially the same as in control populations. The mutation frequency to streptomycin resistance of S. typhimurium, strain SR-11, decreased at doses greater than 0.05 Mrad and increased only slightly for the more radiation-resistant serotypes, S. typhimurium, strain RIA, S. thompson, and S. heidelberg. The average mutation frequency of the four Salmonella cultures tested was essentially unchanged (less than 1 log difference) between 0.05 and 0.5 Mrad, while the difference in reduction in viable numbers was 5 logs or greater. The evidence presented indicates that with the proper choice of processing parameters, the application of radiation pasteurization could drastically reduce the possibility of transmission of Salmonella by poultry and thereby decrease the public health hazards associated with this microorganism. (auth) (Canada)

METALS, CERAMICS, AND OTHER MATERIALS

Metals and Alloys

Refer also to abstract 23758.

Corrosion and Erosion

Refer also to abstract 25987.

24531 (AEC-tr-7183) INTERACTION OF BORON AND CARBIDE WITH AUSTENITIC CHROMONICKEL STEEL IN A MEDIUM OF SODIUM. Smirnov, V. P.; Bespalov, A. G.; Zolotukhin, B. N.; Pavlinov, L. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko- Energeticheskii Institut). Translation of report FEI-119. 21p. Dep. NTIS.

An abstract of this paper, prepared from the original language, appeared as NSA 24: 8053.

24532 (AECL-3799) ENVIRONMENTALLY INDUCED CRACKING OF ZIRCONIUM ALLOYS. III. CRACKING IN HOT AND FUSED SALTS. Cox, B. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Jan 1971. 25p. Dep. NTIS (U. S. Sales Only). AECL $1.00.

Predominantly transgranular cracking of Zircaloy-2 and Zircaloy-4 specimens was observed with deposits of LiCl KCl eutectic, NaCl and CsI at 350°C and in fused eutectic mixtures of sodium and potassium nitrate with potassium iodide at 300 to 450°C. Cracking was not obtained in any medium with U-bend specimens, but split-ring specimens stressed initially to the yield point cracked readily. A number of batches of tubing of various textures were all cracked, although the time to failure varied from batch to batch. The measured time for crack propagation was a minor fraction of the total time to failure, the time for crack initiation being the major fraction. In fused salt mixtures of nitrate and chloride or nitrate and bromide at 300 to 450°C severe intergranular penetration occurred even in the absence of stress. In the latter mixture traces of chloride are thought to act as activators. No cracking, but severe pitting was obtained in fused nitrate/fluoride mixtures. (auth)

24533 (CEA-CONF-1729) DRY CORROSION OF LIGHT METALS OR ALLOYS. Darras, R. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1970. 58p. (In French). (CONF-701040-2). Dep. NTIS (U. S. Sales Only).

From Meeting on Corrosion, Toulouse, France.

Aspects of corrosion in electronuclear reactors are discussed. The nature of the corroding atmospheres and the related temperatures are examined. The possibilities of using Al, Mg, and Be, mostly in the form of alloys, are mentioned. Al spontaneously protects itself by the formation almost everywhere of a fine impermeable layer of alumina, and it is thus a metal very resistant to oxidation. Mg samples can withstand prolonged exposure to dry air at temperatures up to 400°C, the presence of water vapor reduces this temperature to 350°C. Spectacular methods for inhibiting corrosion beneath these temperatures exist. Furthermore the behavior of Mg towards CO_2 at 500°C, which can be reached with the fuel cans, is excellent, even when considerable concentrations of water vapor are present. Phenomena particular to this utilization are indicated. In contrast, Be is very sensitive to traces of water vapor in gaseous atmospheres, particularly in CO_2. Destructive corrosion occurs at 600°C, but can be completely eliminated by the addition of very small quantities of Ca or Mg. (auth)

24534 (EUR-4620) THERMOSIPHON LOOPS FOR CORROSION MEASUREMENTS IN HIGH TEMPERATURE TERPHENYLS. Imarisio, G. C. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 16 Dec 1970. 28p. Dep. NTIS (U. S. Sales Only). EUR F.Fr. 5.60.

Eight thermosiphon loops have been designed and built for corrosion measurements in high temperature terphenyls. The general design criteria are described as well as some peculiar features of the plant. Continuous operation of the loops during about 20,000 hr has shown that these loops are well suited for the long term corrosion measurements which require a trouble free operation. The loops are provided with control of the atmosphere over the terphenyl and of its composition. The water content of the circulating liquid is controllable and constant within ±10% at the 100 ppM level; the temperature is held within ±1°C around 400°C. (auth)

24535 (GEAP-13539-14) SODIUM TECHNOLOGY DEVELOPMENT PROGRAM. MASS TRANSFER INVESTIGATIONS IN LIQUID METAL SYSTEMS. Quarterly Progress Report No. 14, June-August 1970. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Development Operation). Sep 1970. Contract AT(04-3)-189. 31p. Dep. NTIS.

Activities in a program to test corrosion properties of candidate materials for use in large sodium-cooled reactors are summarized. Current work is directed to the near-term data or development requirements of sodium technology for application to FFTF and LMFBR demonstration plant designs. Results of research are included on mass transfer, monitoring of sodium systems, and corrosion of stainless steel. (J.R.D.)

24536 (GEAP-13539-15) SODIUM TECHNOLOGY DEVELOPMENT PROGRAM. MASS TRANSFER INVESTIGATIONS IN LIQUID METAL SYSTEMS. Quarterly Progress Report No. 15, September-November 1970. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Development Operation). Dec 1970. Contract AT(04-3)-189. 39p. Dep. NTIS.

Corrosion of candidate structural materials, the influence of corrosion and of impurities in the sodium on engineering properties of materials, and corrosion and deposition of radioactive isotopes from the core cladding are being studied in test loops designed to simulate typical conditions of sodium-cooled reactors. The program is designed to obtain out-of-pile test data that will (when used in conjunction with irradiation data) support engineering design selections and lead to the establishment of specifications for the monitoring and control of impurities in large plants. Current work is directed to the near-term requirements for data and the development of sodium technology for application to FFTF and LMFBR demonstration plant designs. Emphasis is placed on deposition studies, design data for materials performance, the associated requirements and methods for plant chemistry control, and data on the transport and buildup of radioactive isotopes. Work initiated during the quarter includes the preparations for experimental determination of corrosion release rates of long-lived radioactive isotopes from the core regions of FTR and LMFBR and their deposition patterns in the piping and other components in the cold leg of the primary sodium system. Emphasis is placed on development of a calculational model, based on accurate experimental data, for predicting the buildup of radioactivity in the primary coolant system of large sodium cooled reactors. In the current phase of the program, the number of materials studied has been extended to include cladding candidates for oxide fuel (Types 304, 316, and 347 stainless steels and Incoloy 800). The temperature range of testing has been increased to 1300°F, and temperature profiles, loop geometry, and sodium purity controls have been established to better represent environments of large fast reactors. Increasing emphasis has been placed on improving sodium impurity monitoring and control. In-line devices are used to obtain rapid and, where possible, continuous indications of impurity changes. These include chromatography for cover gas, replaceable flow-through sodium samplers, electrochemical cells for oxygen activity, diffusion cells for hydrogen concentration in sodium and on-line distillation. Research was initiated leading to eventual use of electrochemical cells for carbon. Cold traps for control of sodium purity in test loops have been modified with electromagnetic stirring devices to increase cleanup rate and automatic controls have been added for continuous and unattended operation with an accuracy of ±2°F. (auth)

24537 (KAPL-P-3929) CORROSION OF STRUCTURAL MATERIALS IN WATER-COOLED NUCLEAR POWER PLANTS. Galonian, G. E. (Knolls Atomic Power Lab., Schenectady, N. Y.). 19 Jan 1971. 33p. Dep. NTIS.

Many highly corrosion-resistant structural materials are currently being used successfully in ever-increasing numbers of water-cooled nuclear power plants. This success is due, in part, to an awareness of the operational difficulties and potential plant outages that can result due to high rates of corrosion of plant materials or premature failure by stress corrosion cracking. To avoid excessive amounts of corrosion product generation by general corrosion of surfaces contacted by reactor coolant only the most resistant iron-nickel-chromium, nickel-base, and high chromium steels are used extensively. The composition, heat-treatment, and surface conditioning of the alloys used can influence the corrosion characteristics significantly. The application of these resistant alloys to specific nuclear reactor plant systems requires a thorough knowledge of the water chemistry environments to be contained and the interaction with the material. Even the most highly resistant materials can undergo failure very early in plant life if unusual corrosive conditions or contaminants develop in the water coolant. Generally, the least corrosive water environments are mildly alkaline with no or very low amounts of

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oxygen or chloride. Acidic, oxygenated environments can enhance corrosion appreciably. Highly alkaline waters can induce rapid and extensive failure by caustic stress corrosion cracking. This can occur in the austenitic stainless steel and many nickel-base alloys. The right material must be custom fit to the right water environment to achieve the optimum combination for maximum corrosion resistance. (auth)

24538 (MDC G-2034) REFRACTORY-ALLOY COMPATIBILITY WITH PLUTONIA-238 AT HIGH TEMPERATURE. Interim Report. Andelin, R. L.; Watrous, J. D. (McDonnell Douglas Astronautics Co., Richland, Wash. Donald W. Douglas Labs.). Feb 1971. Contract AT(45-1)-2138. 63p. Dep. NTIS.

Several preliminary conclusions have been reached concerning refractory alloy compatibility with plutonia-238 at high temperatures. Exposure at two plutonia impurity levels, two plutonia oxygen composition levels, and three to six refractory metal alloys at 2000°C for 1000 hours or 1800°C for 2000 hours has resulted in a variety of attack mechanisms. Evaluation by metallographic, microhardness, and electron beam microprobe techniques has been used to identify the mechanisms and provide a basis for selecting compatible combinations. Exposure continues toward a scheduled 15,000 hours at 1800°C, after which the final report will be released. (auth)

24539 (RFP-1592) GALVANIC CORROSION BEHAVIOR OF URANIUM ALLOYS IN HYDROCHLORIC ACID AND OCEAN WATER. Macki, James M.; Kochen, Robert L. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). 24 Feb 1971. Contract AT-(29-1)-1106. 9p. Dep. NTIS.

The galvanic corrosion behaviors of a selected group of alloys in ocean water and hydrochloric acid (HCl) were determined by measuring the gravimetric corrosion rates of galvanically coupled specimens and by constructing a galvanic series for each environment from electrode potential measurements. Based on the gravimetric-galvanic corrosion tests, the galvanic series of the alloys tested, in the order of increasing nobility in 0.1 N HCl at 70°C is: 7178 Al, Tuballoy (depleted uranium), U-4.5 Nb, Type 4340 steel, U-6 Nb, U-8 Nb, U-7.5 Nb-2.5 Zr (Mulberry), U-10 Mo, Ti-6 Al-4 V, and type 304 steel (passive). The galvanic series, based on electrode potentials, in 0.1 N HCl at 25 and 70°C and in ocean water at 25°C, were the same as the series based on the gravimetric-galvanic corrosion tests except for Ti-6 Al-4 V, which occupied a more active position according to the potential measurements. Although they were adjacent to each other in the galvanic series, the type 4340 steel caused the U-4.5 Nb alloy to corrode an order of magnitude faster than the other more noble metals in the series in 0.1 N HCl at 70°C. (auth)

24540 REACTION OF INCONEL WITH OXYGEN-CONTAINING SODIUM. Chiotti, P.; Wu, P. C. S.; Fisher, R. W. (Ames Lab., Iowa). J. Nucl. Mater.; 38: 260-6(Mar 1971).

Metallographic, electron microprobe, and x-ray powder diffraction data were employed to establish the products formed in the reaction band between oxygen-containing sodium and Inconel 600. Hexagonal sodium chromite, $NaCrO_2$, was the principal corrosion product formed at temperatures of 650, 750, and 850°C. The reaction bands showed evidence of grain boundary penetration and internal oxidation; the chromite phase contained little or no iron or nickel while the adjacent metallic phase was highly depleted of chromium. (auth)

24541 CORROSION OF MATERIALS IN REACTOR CONTAINMENT SPRAY SOLUTIONS. Griess, J. C.; Bacarella, A. L. (Oak Ridge National Lab., Tenn.). Nucl. Technol.; 10: 546-53 (Apr 1971). (CONF-700608-26).

From American Nuclear Society meeting; Los Angeles, Calif. (29 Jun 1970).

Spray solutions would be used for pressure reduction and fission product absorption in the event of a serious accident in an aqueous power reactor. These sprays are normally alkaline borate solutions either with or without sodium thiosulfate added. Results of an investigation to determine the corrosion resistance of materials normally present in reactors and associated containment systems in representative spray solutions are presented. Results showed that as a class aluminum alloys were very severely damaged by these solutions. A notable exception was the 5052 alloy which corroded much less at higher temperatures, but at about the same rate as the other aluminum alloys at the lower temperatures. Iron, nickel, copper, and zirconium base alloys as well as structural concrete had adequate resistance to these solutions under all conditions tested. Pure copper was only lightly attacked by the alkaline borate solution but with thiosulfate present the corrosion of copper was greatly increased. (auth)

24542 OXIDATION OF A TERNARY URANIUM ALLOY. Larson, D. T. (Dow Chemical Co., Golden, Colo.). J. Vac. Sci. Technol.; 8: 80-3(Jan-Feb 1971).

From 17th National Meeting of the American Vacuum Society, Washington, D. C. See CONF-701011.

The effect of alloying uranium with 7.5 wt % Nb and 2.5 wt % Zr (Mulberry alloy) on the initial oxidation kinetics (surface oxide thicknesses up to 2000 Å) in air containing water vapor was investigated using an ellipsometer high vacuum system. The uranium alloy samples were oxidized in dry air (<5 ppM H_2O) and air containing water vapor (15,000 ppM H_2O) at a pressure of 650 torr in a temperature range of 22 to 200°C. The results differed from the oxidation of uranium in that the oxidation of this uranium alloy was not enhanced by water vapor under the conditions studied. The oxidation of unalloyed uranium in air is accelerated by water vapor. The oxidation followed a parabolic-rate law, indicating a diffusion-controlled mechanism. An Arrhenius plot of the parabolic reaction rates as a function of the reciprocal temperature revealed a difference in the activation energy of the low-temperature (22-100°C) and high-temperature (100-200°C) oxidation. (auth)

Preparation and Fabrication

Refer also to abstracts 23777, 25036, and 25604.

24543 (RFP-910) INGOT-SHEET BERYLLIUM FABRICATION. Frankeny, Julius L.; Floyd, Dennis R. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). 9 Feb 1968. Contract AT(29-1)-1106. 34p. Dep. NTIS.

Summarized is work done on development of casting and rolling parameters for conversion of scrap, powder-pressed beryllium into ingot sheet. Forming processes of deep-drawing and roll-forming as applied to the ingot sheet are fully discussed. The objectives were to develop economical techniques for fabricating the beryllium-scrap feed into usable shapes and find methods for improving mechanical and physical properties of materials over available commercial powder-metallurgy products. Data are given on results obtained and included also is information on welded joint strengths. (auth)

24544 (RFP-1112) PRECIPITATION IN ELECTRON-BEAM WELDED BERYLLIUM INGOT SHEET. Fraikor, Frederick J.; Hicken, Grant K.; Grotzky, Virgil K. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). 18 Sep 1968. Contract AT(29-1)-1106. 15p. Dep. NTIS.

An investigation was conducted to observe the types, morphology, and behavior of impurity precipitates in beryllium ingot sheet which had been welded by an electron-beam technique. Optical and electron metallography revealed a clear structural transition between the various weld zones. Transmission electron microscopy of the unaffected zone showed dislocation subboundaries 1 to 10 microns in diameter with $AlFeBe_4$ precipitates both in the matrix and subboundaries. In areas where the localized weld heating produced temperatures in excess of 900°C followed by moderate cooling, aluminum-rich grain boundary precipitates were found. Electron-microprobe scanning of weld cracks revealed that these aluminum-rich precipitates introduce hot-short liquid areas which, combined with thermal stresses, produce intergranular cracks. Transmission photomicrographs further showed that the solidification bands consisted of rows of both irregular shaped $AlFeBe_4$ precipitates and platelets of $FeBe_{11}$ interconnected by dislocation subboundaries. It is postulated that these solidification bands are produced by solidification fluctuations with resultant microsegragation of iron and aluminum. (auth)

24545 (RFP-1596) ELECTROCLEANING OF URANIUM ALLOYS. Jackson, Ross J.; Wickland, Charles E. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). 16 Mar 1971. Contract AT(29-1)-1106. 3p. Dep. NTIS.

Discussed are the types of surface oxidation products developed on uranium alloys in several environments. The chemical pickling procedures for removal of the surface oxidation products are reviewed. A proven electrochemical procedure for removal of the surface scale is presented and discussed. (auth)

24546 HYDROGEN FURNACE BRAZING OF LAMPF ACCELERATOR STRUCTURES. Worstell, H. G. (Los Alamos Scientific Lab., N. Mex.). Weld. J. (N. Y.); 50: 161-7(Mar 1971).

Hydrogen furnace brazing is used extensively to assemble the many parts and components required for the Los Alamos Meson Physics Facility (LAMPF) accelerator structures. Brazing filler metals must be compatible with an environment of high vacuum, radiation and high levels of radio frequency power. High temperature tensile strength data for some of the more common filler metals have been obtained. Joint configuration and some of the problems encountered therewith are described and discussed. The

selection of hydrogen furnace brazing as a means to assemble these accelerator structures has proven to be quite satisfactory. It would be difficult indeed to join these heavy sections of copper and stainless steel by any other method without risking excessive warpage, contamination, poor heat transfer or loss of high vacuum integrity. (auth)

24547 ELECTROCHEMICAL PROCESS FOR CUTTING BERYLLIUM. Distler, William B.; Wiesner, Harold J. (to United States Atomic Energy Commission). U. S. Patent 3,556,963. 19 Jan 1971. Filed 9 Jul 1968.

An electrochemical method for cutting beryllium by application of pressure jets of electrolyte, is described. (Official Gazette)

24548 FUEL ELEMENTS. McHugh, William E. (to Atomic Power Development Associates, Inc.). U. S. Patent 3,560,339. 2 Feb 1971. Filed 12 May 1967.

A nuclear reactor fuel element is described having an elongated tubular cladding which contains fuel particles and a disc of smaller diameter than the internal diameter of the cladding. (Official Gazette)

24549 PROCESSING OF BERYLLIUM ALLOY PARTS FOR DIAPHRAGMS OF AIRCRAFT INSTRUMENTS. Ind. Heat.; 37: 860; 862; 864(May 1970).

Diaphragms for aircraft instruments were fabricated from Be–Cu and Be–Ni alloys because of their outstanding spring characteristics. The disks were blanked from coiled strip 0.010 in. thick, then were corrugated and precipitation hardened at 600 to 925°F. Two disks were soldered or electron-beam welded together to form the diaphragms. (Metals Abstr.)

24550 EFFECT OF THE CHEMICAL BOND STRENGTH ON THE ELECTROLYTIC REFINING OF MULTI-COMPONENT SYSTEMS. Suchkov, A. B.; Lobova, T. A.; Gerasimova, I. N. Sb. Tr. Tsent. Nauch.-Issled. Inst. Chern. Met.; No. 70, 118-22 (1969). (In Russian).

Thermodynamic calculations were made of the effect of chemical interactions in the anode material on electrolytic refining processes. These were confirmed experimentally for the systems Ti–Fe, Ti–Fe–C, Nb–Ti–Zr, Nb–Ti–Zr–C (with N or Si). (Referativnyi Zh.)

24551 EVALUATION OF ELECTROWON TUNGSTEN [POWDER FORMED INTO] SHEET. Keith, G. H.; Winston, J. S.; Iverson, H. F. Report of Investigation No. 7385. Washington, D. C.; Department of Interior, Bureau of Mines (1970). 14p.

Electrowon W powders were investigated with respect to consolidation, fabrication, and mechanical properties. Sheet, 0.03 in. thick, was produced and its tensile strength measured between 250 and 1935°C. The large particle size of electrowon W effectively precluded sintering to a density sufficient to allow hot working to sheet or bar. The powders were consolidated by die pressing to 70% density, sheathing in Mo and high-energy-rate extruding to either round or sheet bar of 100% density. The material was then rolled conventionally to sheet. The mechanical properties of the sheet prepared from the electrowon powders compared favorably with those reported in the literature for sheet prepared from commercially produced H-reduced powder. (Metals Abstr.)

Properties Evaluations

Refer also to abstracts 23739, 24626, 24629, 24631, 24658, 26015, 26019, and 26021.

24552 (AECL–3782) STRESS RELAXATION TESTING OF SMALL BENT BEAMS: AN EVALUATION OF SOME OUT-OF-PILE TESTS. Fraser, D. E. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Jan 1971. 24p. Dep. NTIS (U. S. Sales Only). AECL $1.50.

The relative stress relaxation behavior at 300°C of cold-worked Zircaloy-2, cold-worked Zr-2.5 wt % Nb and heat-treated Zr-2.5 wt % Nb pressure tube materials was evaluated and compared using a power function from time hardening creep theory. The function fitted satisfactorily over the time range from 1000 to 10,000 hr. Creep rates calculated from stress relaxation data compared reasonably well with experimental creep data. Relaxation tests to determine relative creep behavior seem promising, but should not be substituted for creep tests to determine design creep data at the present time. (auth)

24553 (BMI–1902) INVESTIGATION OF THE INITIATION AND EXTENT OF DUCTILE PIPE RUPTURE, PHASE II. Progress Report, October–December 1970. Elber, Robert J.; Maxey, Willard A.; Duffy, Arthur R. (Battelle Memorial Inst., Columbus, Ohio). Jan 1971. Contract W-7405-eng-92. 8p. Dep. NTIS.

Phase II studies on the initiation and extent of ductile pipe rupture were continued. Instrumentation for measuring the fracture opening as a function of time was evaluated. The following properties of 24-in. A106B pipe were determined: yield strength, ultimate strength, and elongation at room temperature, 500, and 650°F, chemical composition, Charpy V-notch impact properties, and the NDT temperatures. Two experiments employing part-through circumferential cracks were designed. (G.M.C.)

24554 (EURFNR–875) ROOM TEMPERATURE TENSILE PROPERTIES AND MICROSTRUCTURES OF STEEL X8CrNiMoVNb 1613 (4988), INCOLOY 800 AND INCONEL 718 AFTER AGEING AT 600 TO 800°C. Stumpf, W. E. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material- und Festkoerperforschung). Nov 1970. 39p. (KFK–1318). Dep. NTIS (U. S. Sales Only).

Work performed under United States–Euratom Fast Reactor Exchange Program.

The room temperature tensile properties of all three alloys were correlated with the microstructural changes as observed by the electron microscope. Steel 4988 showed some hardening after prolonged aging at 600°C due to the precipitation of a very fine V(CN) phase. At higher temperatures this phase coarsened rapidly and no hardening was observed. Other carbides in this alloy did not contribute significantly to the mechanical properties except for $M_{23}C_6$ on grain boundaries, which was found only at 600°C and possibly contributed to the lower ductilities of this alloy after aging at 600°C. Similarly, Incoloy 800 was hardened by aging at 600°C, probably due to the formation of pre-precipitation zones of $Ni_3(TiAl)$. Inconel 718 was hardened by aging at 600 and 700°C due to the precipitation of a metastable bct-phase. The formation of NbC films on grain boundaries at 700°C can lead to very low ductilities. It is shown that upon overaging, the transformation from the metastable bct-γ' phase to the stable Ni_3Nb phase occurred with the concomitant dissolution of these NbC films on the grain boundaries, causing an increase in the ductility once again. (auth)

24555 (GEAP–13569) CARBON TRANSPORT METHODS UNDER A TEMPERATURE GRADIENT IN FLOWING SODIUM. Roy, P.; Wozadlo, G. P. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Development Operation). Apr 1970. Contract AT(04-3)-189. 16p. Dep. NTIS.

The state of knowledge on the mode and mechanism of carbon transport, primarily in austenitic systems, is discussed. Included also is a discussion of the effect of carbon transfer on mechanical properties and microstructural changes of austenitic stainless steel after sodium exposure. (auth)

24556 (INIS-mf-6) INFLUENCE OF GRAIN SIZE ON THE MECHANICAL PROPERTIES OF ALPHA ZIRCONIUM. Ramani, S. V.; Rodriguez, P. (Department of Atomic Energy, Bombay (India). Chemistry and Metallurgy Committee). 1970. 14p. (CONF-700218-10). NTIS (U. S. Sales Only).

From Symposium on materials science research; Bangalore, India (24 Feb 1970).

The influence of grain size on the tensile properties of α-zirconium was investigated in the temperature range 77 to 420°K. The yield and flow stresses increased with decreasing grain size obeying the Hall–Petch equation. For zirconium the Petch slope was found to be temperature-dependent, (decreased with increasing temperature). The work-hardening characteristics of the metal were also studied as a function of grain size and temperature. (auth) (INIS)

24557 (ORNL–4667) THEORY OF THE POROUS-FRIT METHOD OF MEASURING SELF-DIFFUSION CONSTANTS. Dresner, Lawrence (Oak Ridge National Lab., Tenn.). Mar 1971. Contract W-7405-eng-26. 47p. Dep. NTIS.

A detailed theory of the radiometric porous-frit method of measuring self-diffusion constants is presented. The results are given in the form of corrections to a simple theory in which the frit is considered to be an infinite homogeneous slab. The effects corrected for are: exposure of the edges of a rectangular parallelepipedal frit; curvature of the exposed inner face of an annular cylindrical frit; and concentration polarization at the exposed surface of the frit. The correction for concentration polarization was calculated for a variety of laminar and turbulent flows. In addition, the relation of the effective diffusion constant of a tracer in a frit to its diffusion constant in the pure pore liquid is discussed. Finally, the applications of the theory to ion-exchange membranes instead of frits is indicated. (auth)

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24558 (ORNL-TM-3289) HIGH-TEMPERATURE BURST STRENGTH AND DUCTILITY OF ZIRCALOY TUBING. Waddell, R. D. Jr.; Rittenhouse, P. L. (Oak Ridge National Lab., Tenn.). Mar 1971. Contract W-7405-eng-26. 20p. Dep. NTIS.

Isothermal tube burst tests were performed to determine the strength, ductility, and failure mode of Zircaloy-4 fuel rod cladding in the temperature range 1100 to 2100°F. Tests were conducted on Zircaloy tubing into which controlled wall defects were introduced as well as on stress-relieved material containing no wall defects. The defects were designed to simulate those that might be formed during loading of a reactor core or as a result of corrosion. At all test temperatures, the undefected material showed circumferential strains in excess of 50%. The presence of wall defects did not affect rupture stress but did, depending on the type of defect, influence rupture location as well as magnitude of the expansion. (auth)

24559 (ORNL-TM-3297) ADDITIONAL EXPERIMENTS ON ELECTROLESS NICKEL COATINGS FOR HIGH-PERFORMANCE ALUMINUM FUEL PLATES. Griess, J. C.; Cheverton, R. D.; McGuffey, J. R. (Oak Ridge National Lab., Tenn.). Mar 1971. Contract W-7405-eng-26. 19p. Dep. NTIS.

Electroless nickel coatings on aluminum were investigated using electrically heated water-cooled specimens in an out-reactor flow loop, and also using nickel-coated fuel plates in-reactor. The out-reactor experiments indicated that the as plated coatings had sufficient ductility and adherence to withstand higher temperatures, temperature gradients, and coolant velocities than encountered in present-day high performance research reactors. The in-reactor experiments, however, resulted in essentially complete loss of the nickel coating in a brief period of time. Possible mechanisms for in-reactor loss have been suggested. It is possible that operation with pure water (pH ≅ 7) and hydrogen addition would preserve the integrity of the nickel coating. It is recommended that such an experiment be conducted. (auth)

24560 (SC-RR-70-860) EFFECT OF CHLORIDE IONS ON THE SUSCEPTABILITY TO STRESS CORROSION CRACKING OF U-7½ WT PERCENT Nb-2½ WT PERCENT Zr AND U-4½ WT PERCENT Nb ALLOYS. Magnani, Nicholas J.; Romero, Herman; Miglionico, Charles J. (Sandia Labs., Albuquerque, N. Mex.). Dec 1970. 23p. Dep. NTIS.

The effect of chloride ions on the stress corrosion cracking behavior of U-7½ wt % Nb-2½ wt % Zr (Mulberry) and U-4½ wt % Nb was studied in this investigation. The fracture mode and critical stress intensity for stress corrosion cracking (K_{ISCC}) of Mulberry were strongly dependent on chloride concentration. A mixed transgranular (quasi-cleavage) and intergranular mode was observed in Mulberry tested in solutions of <2 ppM Cl; this type of cracking had a K_{ISCC} value of 15 KSI/in. An intergranular mode was observed on samples tested in 50 ppM chloride solutions and this type of cracking had a K_{ISCC} value of <5 KSI/in. For the binary alloy neither the fracture mode nor K_{ISCC} was a strong function of the chloride content of the solution. A transgranular mode (not resembling the quasi-cleavage found in Mulberry) was observed in binary alloy samples tested in <2 ppM chloride solutions, and either a transgranular or a mixed transgranular plus intergranular mode was observed in samples tested in 50 ppM chloride solutions. The K_{ISCC} value for cracking in solutions of both chloride concentrations was approximately 15 KSI/in. (auth)

24561 (TRG-Report-2071) THE USE OF STABILISED STEELS IN THE P.F.R. CIRCUIT. Watkins, B.; Dickinson, F. S.; Turner, F.; Jackson, H. (United Kingdom Atomic Energy Authority, Culcheth (England). Reactor Group). 1970. 21p. Dep. NTIS (U. S. Sales Only).

Cost considerations and the risk of stress corrosion cracking make ferritic steels the preferred structural materials for low temperature components in PFR circuits. Steels containing carbide stabilizers are however necessary due to decarburization and consequent loss of strength on exposure to sodium. An optimization study of the mechanical properties of stabilized steels led to the selection of an Nb stabilized 2¼ Cr 1 Mo steel for the evaporators and a stabilized mild steel for other components. Stabilized steels were used for neutron shield tubes, evaporator boiler tubes and some secondary circuit components. Thus stabilized steels were used as plates, tubes and forgings. Fabrication experience with these components is discussed. The high integrity requirements of boiler components necessitated particular attention being paid to tube/tube plate welds. Despite the exceptionally high level of quality control applied to these welds both radiographic and ultrasonic techniques were developed to supplement visual inspection and leak detection. The application of these techniques to stabilized steel welds is discussed. The use of stabilized steels for higher temperature applications and alternative tube to tube plate welds are briefly discussed. (auth)

24562 (UCRL-50958) PRECIPITATION HARDENING OF Mo-1 AT. PERCENT Hf BY INTERNAL NITRIDING. Mitchell, J. B.; Himmel, L.; Kane, J. S. (California Univ., Livermore. Lawrence Radiation Lab.). 19 Oct 1970. 27p. Dep. NTIS.

Precipitation hardening of 0.050-in.-thick sheets of a Mo-1 at. % Hf solid-solution alloy was accomplished by internal nitriding which produced a homogeneous dispersion of coherent plate-like HfN precipitates oriented on {001} planes of the molybdenum matrix. The high-temperature tensile strength of this alloy is substantially superior to that of TZM and TZC. During internal nitriding, growth of the HfN particles occurs at the advancing nitriding front by Ostwald ripening which produces an increase in average particle size with increasing depth below the external surface. The high nitrogen activity in the alloy behind the nitriding front effectively inhibits dissociation and growth of the precipitates. The plate-like HfN particles grow in diameter in a coherent manner. Thickening of the particles occurs by the nucleation and growth of coherent ledges on the planar surfaces. This thickening process produces an increase in the coherency strain which is relaxed by the formation of intrinsic dislocation loops within the particles by the coalescence of vacancies. The large HfN particles developed by this growth mechanism retain substantial coherency strain. A severe particle-coarsening mechanism is operative at high temperatures in regions of the nitrided alloy containing a high density of small fully coherent precipitates. The coarsening occurs by the migration of grain boundaries which sweep up the small fully coherent precipitates, the components of which then feed large semicoherent particles growing behind the boundary. (auth)

24563 (WARD-4135-14) STAINLESS STEEL CLADDING DEVELOPMENT QUARTERLY PROGRESS REPORT FOR THE PERIOD ENDING SEPTEMBER 30, 1970. Ray, William E. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). Dec 1970. Contract AT(30-1)-4135. 36p. Dep. NTIS.

Microcharacterization and mechanical property testing, including biaxial tensile, biaxial stress rupture, and both uniaxial and biaxial creep were continued on ARD vacuum melted materials. Stress rupture tests were continued; the results from seven lots of material representing various combinations of the independent variables were compared. Classification of the mode of rupture of post-test biaxial stress rupture specimens continued. Strain measurements of fifteen specimens were completed and results compared. Metallographic examination of selected specimens from this group was planned. Non-destructive testing equipment was received and installed. Preliminary eddy current tests were made for two lots of tubing. Sixteen stress rupture tests were completed. Results from ARD, double vacuum melted, Type 316 tubing, in the cold worked condition and in the annealed condition were compared. Upgrading of a uniaxial creep facility was initiated so that low stress creep data may be obtained. A total of 131 post-test stress rupture specimens were classified according to rupture type, stress level, and material, at both 1200 and 1300°F. Nine of the fifteen post-test stress rupture specimens, which were previously measured for longitudinal strain profiles, were further evaluated by circumferential wall thickness measurements at various locations along the length of the specimen. Examination of the variations in localized strain around the section circumference led to some observations and evaluations relative to both material properties and mechanical effects on stress rupture results. Five of these nine specimens were also examined metallographically. The change in slope in the stress rupture curve for the cold worked, planetary swaged material was correlated with recrystallization on the OD of the tubing. (auth)

24564 PROCESS FOR THE PREVENTION OR REDUCTION OF CARBON DEPOSITS ON METAL SURFACES IN A NUCLEAR REACTOR. Karcher, Walter (to EURATOM). U. S. Patent 3,560,336. 2 Feb 1971. Priority date 19 Mar 1967, Netherlands.

A method is described for reducing carbon deposits on the metal surfaces of heat exchangers in a nuclear reactor. The reactor operated at a high temperature and was cooled with gas which comprises adding up to 0.1 gram of a silane such as triethyl silane per liter of cooling gas to the cooling gas either in the heat exchanger or upstream just preceding the heat exchanger. (Official Gazette)

24565 INFLUENCE OF STRESS INTERACTION EFFECTS UPON PORE MOTION IN SOLIDS. Leiden, S. H.; Nichols, F. A. (Westinghouse Electric Corp., West Mifflin, Pa.). J. Nucl. Mater.; 38: 309-18(Mar 1971).

A computer oriented analysis was undertaken in an attempt to fix the sign and magnitude of the response of a pore to a stress field. The present results agreed very well with an analytical result of other authors for the interaction of two bubbles within a solid continuum and reasonably well with their approximate ana-

lytical result for the interaction between a bubble and a free surface. The interaction between a bubble and a clamped surface was obtained. Two bubbles will always attract as long as at least one contains some uncompensated pressure. Further, such a bubble will be attracted to a free surface and repelled from a clamped surface. An analytical solution to the problem of an equilibrium bubble placed in a linear uniaxial stress gradient indicated the bubble will move up the gradient, whether the gradient was produced by external tension or compression. This was compared with a previous result for a pressure gradient; the uniaxial stress produced a force about 50% higher than that due to a pressure gradient. Finally, estimates are made for the magnitude of these forces under physically plausible conditions. (auth)

24566 STORAGE BEHAVIOR OF PLUTONIUM METAL, ALLOYS, AND OXIDE. A REVIEW. Stakebake, J. L. (Dow Chemical Co., Golden, Colo.). Contract AT(29-1)-1106. J. Nucl. Mater.; 38: 241-59(Mar 1971).

Factors which are of primary concern in the storage of plutonium metal include: its corrosion susceptibility, its pyrophoricity, and its radiation properties. Each of these factors is reviewed with particular consideration given to that work done after 1964. Plutonium dioxide was one of the most satisfactory forms in which to store plutonium for long periods. However, adsorption of gases and vapors on the oxide can affect its storage behavior. Such adsorption can result in future pressurization of sealed storage containers. Adsorption of oxygen, water vapor, carbon dioxide, and nitrogen oxides is discussed. The radioactive nature of plutonium and plutonium compounds can also adversely affect long term storage. Radiation may decompose adsorbed contaminants as well as associated wrapping materials resulting in possible pressurization of sealed containers and degradation of the metal. (auth)

24567 SELF-DIFFUSION OF PLUTONIUM IN A Pu/1 WT. % Ga ALLOY. Wade, W. Z. (Univ. of California, Livermore). J. Nucl. Mater.; 38: 292-302(Mar 1971).

The self-diffusion coefficients for plutonium in a Pu/1 wt % Ga delta-stabilized alloy were determined in the temperature range of 240 to 644°C. Using the thin film ^{238}Pu tracer technique, the diffusion coefficients are as follows: ϵ phase (574 to 644°C), $D^* = 7.0 \times 10^{-4} \exp(-13{,}400/RT)$ cm^2/sec; δ_1 phase (340 to 508°C), $D^* = 76 \exp(-36{,}300/RT)$ cm^2/sec; and δ_2 phase (240 to 340°C), $D^* = 1.6 \times 10^{-2} \exp(-26{,}300/RT)$ cm^2/sec. Where δ_1 = delta phase temperature range where volume diffusion is dominant and δ_2 = delta phase temperature range where grain boundary diffusion was proven significant. (auth)

24568 AN ATTEMPT TO DETERMINE THE ACTIVATION VOLUMES FOR SELF-DIFFUSION IN BIVALENT AND TRIVALENT METALS. Beyeler, Michel (CEA, Saclay, France); Adda, Yves; Lazarus, David. pp 255-60 of Les Proprietes Physiques des Solides Sous Pression. Paris; Centre National de la Recherche Scientifique (1970). (In French).

From International Conference on the Physical Properties of Solids Under Pressure, Grenoble, France. See CONF-690908.

The self-diffusion of Al and Be was investigated for single crystals treated under pressure of 0 to 8 kbar in a temperature range of 400 to 610°C for Al and at 693°C in the case of Be. The pressure effect on the self-diffusion coefficients in these metals and on the activation energy of self-diffusion in aluminum was measured. The activation volumes obtained (1.30 molar volume for Al and 1.20 for Be) are in good agreement with theory. (auth) (France)

24569 TEMPERATURE AND PRESSURE EFFECTS ON ELASTIC MODULI OF GADOLINIUM SINGLE CRYSTALS. Fisher, E. S. (Argonne National Lab., Ill.); Goodman, G. M.; Manghnani, M. H.; Benzing, W. M. pp 311-17 of Les Proprietes Physiques des Solides Sous Pression. Paris; Centre National de la Recherche Scientifique (1970).

From International Conference on the Physical Properties of Solids Under Pressure, Grenoble, France. See CONF-690908.

The effects of hydrostatic pressures up to 3 kbar on the single-crystal elastic moduli of Gd metal were measured at 298 and 273°K. The effect of pressure on the temperature dependence of C_{33} between 298 and 273°K was observed. With exception for the C_{44} shear mode, the pressure coefficients of the stiffness moduli and the Grueneisen mode gammas are significantly decreased by ferromagnetic ordering. The isothermal pressure derivative of the bulk modulus is 1.68 at 273°K in contrast to 3.11 at 298°K. The effects of ferromagnetic ordering observed in the temperature dependence of the elastic moduli are mostly intrinsic effects not caused by the volume magnetostriction. The pressure dependence of T_c as indicated by the C_{33} modulus is −1.60°K/kbar. (auth) (France)

24570 SHEARING OF BULK Cu, Be, AND W UNDER NEARLY HYDROSTATIC PRESSURE TO 70 KILOBARS. Abey, A. E. (Univ. of California, Livermore). pp 473-6 of Les Proprietes Physiques des Solides Sous Pression. Paris; Centre National de la Recherche Scientifique (1970).

From International Conference on the Physical Properties of Solids Under Pressure, Grenoble, France. See CONF-690908.

A new apparatus was developed to shear bulk metal samples at pressure up to 70 kbar. The apparatus is explained in detail and some data for Cu, Be, and W are presented. (auth) (France)

24571 EVAPORATION CHARACTERISTICS OF MATERIALS FROM AN ELECTRON-BEAM GUN. Graper, Edward B. (Sloan Instruments Corp., Santa Barbara, Calif.). J. Vac. Sci. Technol.; 8: 333-7(Jan-Feb 1971).

From 17th National Meeting of the American Vacuum Society, Washington, D. C. See CONF-701011.

Measurements have been made of the evaporation characteristics of aluminum, alumina, aluminum nitride, barium titanate, boron carbide, boron nitride, carbon, copper, chromium, gold, iron, inconel, lead, magnesium, magnesium fluoride, molybdenum, nickel, niobium, permalloy, sapphire, silicon, silicon monoxide, silicon dioxide, silver, tantalum, tin, tin oxide, titanium, titanium monoxide, titanium dioxide, tungsten, and zinc. Using a 6-kW, 180° bent-beam gun, the deposition rate, required beam power, charge material form, and suitability for evaporation were determined for each material. The evaporation rate is reported in angstroms/minute. Methods of transferring these data to other guns are developed. The beam power limit is discussed and methods of increasing the evaporation rate of power limited materials are explored. Extension of these results to other materials is discussed and examples are given. (auth)

24572 LEGKIE SPLAVY I METODY IKH OBRABOTKI. (Light Alloys and Methods of Treating Them). Drits, M. E. (ed.). Moscow; Izdatel'stvo Nauka (1968). 304p.

Forty-one articles are included on various methods for treating Al, Mg, and Ti alloys and improving technological processes for semifinished products. Refining of alloys, rolling, and high compression processes are discussed. A separate abstract was prepared for each of five articles of special interest. (R.V.J.)

For abstracts of individual papers see: 24573–24575, 24597, and 24598.

24573 INFLUENCE OF PLASTIC DEFORMATION AND ANNEALING ON THE ULTRASONIC DAMPING IN Mg AND Mg–Nd ALLOYS IN THE MHz RANGE OF FREQUENCIES. Drits, M. E.; Rokhlin, L. L.; Zusman, L. L. pp 225-30 of Legkie Splavy i Metody ikh Obrabotki. /Drits, M. E. (ed.). Moscow; Izdatel'stvo Nauka (1968). (In Russian).

The influence of cold hardening and annealing on the ultrasonic damping of metals of several tens of megahertz frequencies was studied using polycrystalline magnesium and Mg–2.3% Nd. The results showed that the ultrasonic damping, as a result of plastic deformation and annealing, corresponded to the dislocation theory of absorption (the distortion of the crystalline lattice) and to the theory describing ultrasonic damping in polycrystalline materials. (R.V.J.)

24574 ULTRASONIC DAMPING IN Mg–Cd and Mg–Zn AT 10 AND 20 MHz. Zusman, L. L. pp 230-2 of Legkie Splavy i Metody ikh Obrabotki. /Drits, M. E. (ed.). Moscow; Izdatel'stvo Nauka (1968). (In Russian).

Studies of the influence of cadmium and zinc on the ultrasonic damping in Mg at 10 to 20 MHz frequencies are described. It was found that alloying Mg with Cd and Zn reduced the ultrasonic damping. (R.V.J.)

24575 TITANIUM AND ITS ALLOYS. Bokshtein, S. Z.; Emel'yanova, T. A.; Kishkin, S. T.; Mirskii, L. M. pp 254-61 of Legkie Splavy i Metody ikh Obrabotki. /Drits, M. E. (ed.). Moscow; Izdatel'stvo Nauka (1968). (In Russian).

The diffusion constants of nickel in commercial titanium and in its alloys with Al, Mo, and Nb were investigated by means of tracer atoms. It was found that alloying titanium with α-stabilizing aluminum decreased the nickel mobility in the β-phase. The minimum Ni mobility was observed in an alloy with a thermally stable β-phase containing 45% Nb. The effect of β-stabilizers on the penetrability of the β-phase increased with an increase in temperature. An appreciable decrease in the nickel diffusion coefficient was attained with an increase in the oxygen concentration in titanium and its alloys. It is suggested that an anomalously high diffusion mobility of substitution elements inside the grains during polymorphic transformations may be caused by stable structural defects. (auth)

XUM

24576 TENSILE DEFORMATION OF VAPOR-DEPOSITED COPPER REINFORCED WITH TUNGSTEN WIRES. Jenkins, William D.; Willard, William A.; Harne, Donald E. (National Bureau of Standards, Washington, D. C.). J. Res. Nat. Bur. Stand.; 74C: 97-110(Jul-Dec 1970).

Short-time tensile tests were made at room temperature on sheet specimens of vapor-deposited copper containing zero to 26 volume percent continuous tungsten wires having diameters of 0.0005, 0.001, and 0.005-inch. Specimens were annealed at 25, 300, and 600°C prior to testing. Strength, ductility, shape of the stress-strain curves, and types of fractures were influenced by volume fraction and number of layers of wires as well as by wire diameter and alinement. Strength values for the composites with 2 to 3% volume fractions of wires exceeded those predicted by the law of mixtures whereas at higher volume fractions, either conformance to the law was observed or lower values than those predicted were obtained. Increase in strength was accompanied by a decrease in electrical conductivity. All the properties investigated were markedly affected by increasing the annealing temperature. Tungsten wires failed in a ductile manner after considerable localized deformation (necking) in various sections of the wires. (auth)

24577 EFFECT OF PRESSURE ON THE ISOTOPE EFFECT IN SODIUM SELF-DIFFUSION. Mundy, John N. (Argonne National Lab., Ill.). Phys. Rev., B; 3: 2431-45(15 Apr 1971).

The diffusion of ^{22}Na in sodium has been measured over the temperature range −78.5 to 97°C and the data do not fit a linear Arrhenius relation. The data indicate that at least two, and possibly three, jump mechanisms could be responsible for the diffusion behavior. The diffusion of ^{22}Na in sodium has been measured as a function of pressure over the range from ambient pressure to 9500 kg cm^{-2} at 14.8 and 91.3°C. The lnD-vs-pressure results also show curvature and are in substantial agreement with the ambient-pressure data. Isotope-effect measurements have been made over the temperature range −25.0 to 97°C at ambient pressure. The isotope effect decreases as the temperature increases over the entire temperature range, with a more rapid decrease above 70°C. Isotope-effect measurements have been made at 7000 kg cm^{-2} over a temperature range 14.8 to 117°C. The effect of pressure on the isotope effect is not large. The variation of isotope effect with temperature appears to be less at 7000 kg cm^{-2}. Collectively, the data are interpreted in terms of one, two, or three mechanisms of diffusion. It is not possible to determine unambiguously the mechanisms of diffusion in sodium. The evidence appears to favor a vacancy mechanism at low temperatures with an increasing contribution from divacancies as the melting temperature is approached. (auth)

24578 FATIGUE-CRACK PROPAGATION BEHAVIOR OF TYPE 304 STAINLESS STEEL AT ELEVATED TEMPERATURES. James, Lee A. (WADCO Corp., Richland, Wash.); Schwenk, Earl B. Jr. Met. Trans.: 2: 491-6(Feb 1971).

The fatigue-crack propagation behavior of Type 304 stainless steel was investigated within the framework of linear elastic fracture mechanics at 75 to 1200°F. The cyclic frequency for the elevated temperature tests was 4 cpm. It was found that, in general, fracture mechanics concepts may be used to describe the crack propagation behavior at these temperatures, and that increasing the temperature had a significant effect in increasing the fatigue-crack growth rate. (auth)

24579 INVESTIGATION OF THERMODYNAMICS OF V–O SOLID SOLUTIONS BY DISTRIBUTION COEFFICIENT MEASUREMENTS IN THE V–O–Na SYSTEM. Smith, Dale L. (Argonne National Lab., Ill.). Met. Trans.; 2: 579-83(Feb 1971).

The activity coefficient of oxygen in vanadium was determined at 600 to 750°C by equilibrium distribution coefficient measurements in the V–O–Na system. The activity of oxygen in vanadium exhibited a significant negative deviation from Raoult's law (standard states: $\gamma = 1$ at $N = N^0$). The activity coefficient was adequately expressed by the reciprocal temperature dependence, which was characteristic of a regular solution. The low oxygen pressures required for this investigation were attained by controlling the oxygen concentration in liquid sodium at levels below 20 ppM. The $V_{(O\ sat)}-O_{Na}-V_2O$ phase boundary and the equilibrium distribution of oxygen between vanadium and sodium were also determined in the temperature range 500 to 850°C. (auth)

24580 THERMODYNAMICS OF FORMATION OF Th–Co ALLOYS. Skelton, W. H.; Magnani, N. J.; Smith, J. F. (Ames Lab., Iowa). Met. Trans.; 2: 473-6(Feb 1971).

Electromotive force cells were used to determine the Gibbs free energies, enthalpies, and entropies of formation for Th_2Co_{17}, $ThCo_5$, Th_2Co_7, ThCo, and Th_7Co_3. Solid CaF_2 was employed as the electrolyte, and measurements were made over the temperature range 917 to 1233°K. Comparison of the Th–Co enthalpy values with Th–Ni values showed that the relative bond strengths associated with thorium–transition metal interactions in the two systems inverted between the thorium-poor and thorium-rich regions. (auth)

24581 TRENDS IN BEARINGS AND LUBRICATION. III. PLAIN-BEARING MATERIALS. Booser, E. R. Mach. Design; 42: No. 15, 14-20(18 Jun 1970).

Performance characteristics, such as load carrying capacity, max operating temperature, compatibility and corrosion resistance, and physical properties including hardness, tensile strength, modulus of elasticity, and thermal conductivity are tabulated for Sn- and Pb-base babbitt, Cd, Cu–Pb, Pb bronze, Sn bronze, Al alloy, and Ag sleeve-bearing materials. Applications of these materials are described separately. Plastics, rubber, wood, cermets, ceramics and sapphire and glass are also covered briefly. (Metals Abstr.)

24582 STUDY OF THE MECHANICAL AND ELASTIC PROPERTIES OF ALLOYS OF THE NICKEL–CHROMIUM–NIOBIUM SYSTEM. Barseg'yan, L. V.; Belov, B. G.; Platova, S. N. Sb. Tr. Tsent. Nauch.-Issled. Inst. Chern. Met.; No. 71, 199-207 (1969). (In Russian).

A study was made of various properties of dispersion-hardened ternary Ni-base alloys containing Nb 6 to 16 and Cr 2 to 25% and additionally alloyed with Al 1 to 2%. Mechanical, elastic, and relaxation properties as well as the microstructure after various heat treatment regimes were studied. The corrosion resistance in several media based on concentrated nitric acid is reported. (Referativnyi Zh.)

24583 SOME FEATURES OF ALLOYS OF ZINC WITH INDIUM, LEAD, AND MERCURY PRODUCED BY TREATING ZINC FOIL IN AMALGAMATED SOLUTIONS CONTAINING INDIUM AND LEAD. Lainer, D. I.; Bulgacheva, N. M.; Dorokhina, L. N.; Neiman, E. Ya. Tr. Gos. Nauch.-Issled. Proekt. Inst. Splavov Obrab. Tsvetn. Metal.; No. 31, 9-19(1970). (In Russian).

A comparison was made of the composition, structure, and electrochemical, corrosion, and mechanical properties of alloys of Zn with In and Pb. The alloys were prepared by casting or by the contact precipitation of In and Pb onto Zn foil from amalgamated solutions. The best improvement in corrosion properties was shown by alloys prepared by the contact method, although the distribution of the additives in such alloys was less uniform. Thus, the additives were concentrated mainly in the surface layers and, when large concentrations of In and Pb were used, this had a deleterious effect on the electrochemical properties. (Referativnyi Zh.)

24584 OXIDATION RESISTANT COATINGS FOR REFRACTORY METALS. Allen, B. C. DMIC Rev.; 3p(8 May 1970).

Performance reports are given for five coatings to protect Ta–10W and T-222 Ta alloys from air oxidation up to 4000°F. The coatings tested were Hf–20Ta–0.25Si (R515), R515 + 2 Al, W/Si–W duplex coating, 95W–5Ti/Si duplex coating and W + Ti/Si–W slurry-sinter coating. The results of a 3 year study on the total normal emittance of coated refractory metals as a function of pressure and temperature are reported for four coating systems; Cr–Tr–Si/Nb-752, Chromalloy W-3/Mo-TZM, Sn–26.5 Al–5.5 Mo/Ta–10W and Si–20Cr–20Fe/Nb-752. References are given to papers relating to the properties of refractory metal alloys with and without protective oxidation-resistant coatings. (Metals Abstr.)

24585 PREPARATION AND PROPERTIES OF CHROMIUM–ZIRCONIUM–CARBON ALLOYS. Rogers, J. A.; Hopkins, B. E. (National Physical Lab., Teddington, Eng.). J. Less-Common Metals; 23: 293-305(Mar 1971).

The potential of the Cr–Zr–C system as a base for the development of an alloy suitable for use at temperatures in excess of 1000°C was examined. Zirconium content and zirconium to carbon ratio were varied in a series of Cr–Zr and Cr–Zr–C alloys prepared by consumable arc-melting and extrusion. The coarse zirconium carbide particles obtained in these alloys in the cast condition were greatly modified by extrusion at very high temperatures but no response to subsequent solution and aging treatment was obtained from any of the alloys. However, the coarse zirconium carbide appeared to be very stable at 1050°C, and a three-fold increase in the stress required for the creep rupture of chromium in 100 hr, in air, at 1050°C, was obtained with a Cr–2.42Zr–0.11C alloy tested in the as-extruded condition. The ductile-to-brittle transition temperature of this alloy in the recrystallized condition was in excess of 500°C when determined in a bulge test designed for testing small samples.

The ductile-to-brittle transition temperatures of all the other alloys investigated were also above room temperature. Zirconium in solution in chromium provided some solid-solution strengthening and proved to be a powerful grain refiner. (auth)

24586 COMBUSTION OF PULSE-HEATED SINGLE PARTICLES OF ALUMINUM AND BERYLLIUM. Prentice, Jack L. (Naval Weapons Center, China Lake, Calif.). Combust. Sci. Technol.; 1: 385-98(1 Apr 1970).

Experimental studies of the combustion of single particles of aluminum and beryllium in a variety of oxidizers are described. Experiments were performed using both a pulsed Nd-glass laser and a xenon flash heating device as ignition sources. A scanning electron microscope (SEM) served as the major diagnostic tool in particle quenching studies. Major differences in the combustion of aluminum and beryllium were found and were related to the thermophysical properties of the metals and their respective oxides. New data on the burning rate of laser-ignited aluminum particles are presented. Scanning electron microscope pictures of the evolution of geometry of burning beryllium particles are presented. The effect of water vapor on the combustion of beryllium particles is documented. A discussion of the mechanism of metal particle fragmentation is included. (auth)

24587 EFFECT OF GAS ATOMS ON RECOVERY OF WORK HARDENING IN Al–Li ALLOYS. Shiraishi, Kensuke (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 8: 110-12(Feb 1971).

Recovery of work hardening was retarded by gas atom clusters in Al-0.4 wt % Li specimens irradiated to a low fluence (1×10^{19} cm^{-2}). When the specimen was irradiated further (3×10^{19} cm^{-2}), radiation hardening covered up the work hardening, and recovery of the hardening is retarded by post-irradiation cold-working. With Al-2.7 wt % Li alloy, the results could not be obtained with such clarity because of the complicated hardening process involved in this case. It should further be noted that the annealing behavior of radiation-induced hardening measured in relation to change in hardness is rather different from that measured with tensile test. (auth)

24588 CREEP AND STRENGTH AT ELEVATED TEMPERATURES OF [NIOBIUM] VN-2 ALLOY. Krivenyuk, V. V.; Makovetskii, I. V. Probl. Prochnosti; No. 3, 29-32(Mar 1970). (In Russian).

Experimental data are given on the creep behavior and strength at high temperature (1000 to 1400°C) of Nb VN-2 alloy containing C 0.014, Cr < 0.01, Mo 4.35, and O < 0.03%. Power functions were obtained for the variation of initial strain rate and life of the specimen with stress at high temperature. The validity of the exponential dependence of hardness and strength on temperature is confirmed for the alloy. (Metals Abstr.)

24589 EFFECTS OF HYDROGEN GAS ON METALS AT AMBIENT TEMPERATURE. Campbell, J. E. DMIC Report No. S-31. Columbus, Ohio; Battelle Memorial Institute (1970). 19p.

The effects of H gas on pure Fe, C and alloy steels, stainless steels, Al and Al alloys, Cu, Be–Cu, Ni, and Ni alloys and Ti and its alloys were studied by tension, burst, and fatigue tests. Results showed that ferritic, martensitic, and bainitic steels, Ni alloys and Ti alloys became embrittled in pure H gas environments at ambient temperature, an effect which became more pronounced as the H gas pressure was increased as the strength of the alloy increased. This embrittlement was most obvious in the notched specimen data which indicated a marked reduction in notch strength, but the reduction in ductility of the unnotched specimens was also an indication of the onset of H embrittlement. Tests on the stable austenitic stainless steels such as 310 and 316, on the Al alloys 6061-T6, 2219-T6 and 7075-T73 and Be–Cu showed no significant evidence of embrittlement in H gas at up to 10,000 lb/in^2. (Metals Abstr.)

24590 EFFECTS OF PROCESSING ON THE DIMENSIONAL STABILITY OF BERYLLIUM MIRRORS. Maringer, R. E. DMIC Memo No. 248. Columbus, Ohio; Battelle Memorial Institute (1970). 6p.

Four distinct mechanisms of dimensional instability were identified in Be that can be electrodeless Ni plated for use in mirrors: relaxation of residual stresses introduced during processing (especially machining); relaxation of residual stresses existing in the Ni plate or of thermally induced stresses between the plate and the Be substrate; relaxation of thermally induced residual stresses resulting from the anisotropy of the thermal expansion coefficients of Be; and a nonuniformity of the preferred orientation of Be, which results in nonuniformity of thermally induced stresses. Machine surfaces should be chemically etched and then given a stress-relief heat treatment. Plating should only be used where a polishable surface cannot be otherwise attained and should be plated over the entire surface to an even thickness. Slow cooling after stress-relief heat treatment is important to permit partial relaxation of intergranular stresses. Both the hot isostatic pressing and pressureless sintering processes reduce the nonuniformity of the preferred orientation in Be. (Metals Abstr.) Abstr.)

24591 DEVELOPMENT OF HIGH-TEMPERATURE VANADIUM-BASE ALLOY. Keith, G. H.; Winston, J. S. Report of Investigation No. 7393. Washington, D. C.; Department of Interior, Bureau of Mines (1970). 13p.

A V-base alloy, consisting of 20 wt % Mo, 10% Ti, 0.1% C, 0.5% Si and 0.5% Y, had exceptionally high strength at temperatures up to 1200°C. This alloy was capable of fabrication to sheet of ~1 mm thickness by a combination of hot swaging and hot and warm rolling. In the warm rolled condition at ambient temperature, its ultimate tensile strength was 1205 MN/m^2. The strength at 1200°C was 150 MN/m^2. Within the temperature range of 25 to 1200°C, the ductility of the alloy, as measured by elongation, increased from 4 to >90%. Strengthening was achieved by both solid-solution and dispersed-phase mechanisms. Alloys of 20% Mo and 10% Ti were stronger than the other Mo–Ti alloy compositions tested. Strength was increased 15% in the temperature range of 25 to 800°C, with no accompanying loss in ductility, by the addition of 0.5% Si. Workability was improved by additions of 0.25 and 0.5% Y. (Metals Abstr.)

Structure and Phase Studies

Refer also to abstracts 25229, 25242, and 25247.

24592 (CEA-R-4023) RELATIONSHIP BETWEEN RADIOACTIVE IRON AND CHROMIUM DIFFUSION IN Fe–Cr ALLOYS CONTAINING 0–15 PER CENT Cr, AND THE $\alpha \rightleftharpoons (\alpha + \gamma) \rightleftharpoons \gamma$ TRANSFORMATIONS. EFFECT OF CARBON IMPURITIES. Huntz, Anne-Marie (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Nov 1970. 159p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

To relate the diffusion phenomena to the $\alpha \rightleftharpoons (\alpha + \gamma) \rightleftharpoons \gamma$ phase transformation, the volume and grain boundary diffusion coefficients measurements of ^{59}Fe and ^{51}Cr were carried out in Fe–Cr alloys, with Cr compositions in the γ loop, in the α or γ single phase or the duplex ($\alpha + \gamma$) phase, using the generalized Gruzin method, and the Suzuoka analysis, for grain boundary diffusion. Metallographic studies of the alloys microstructure and autoradiographic techniques enabled preferential diffusion phenomena to be examined in interfaces and to specify the phase transformation mechanisms. By static methods, the curves defining the γ loop were accurately determined. Carbon, in trace quantities, when segregated to the grain boundaries decreased the rate of chromium or iron boundary diffusion. It widened the γ loop and had a large influence on the microstructure of γ crystals during their growth, and on the $\gamma \rightarrow \alpha$ transformation during cooling. The autoradiographic technique showed that the γ crystals transform to a martensite nucleus surrounded by a ferrite border. This phenomenon is related to a carbon concentration gradient. (auth)

24593 (INIS-mf-17) X-RAY STUDY OF COLD WORKED BCC TANTALUM–NIOBIUM AND TANTALUM–MOLYBDENUM ALLOYS. Kumar, L.; Krishnan, R. (Department of Atomic Energy, Bombay (India). Chemistry and Metallurgy Committee). 1970. 13p. (CONF-700218-6). NTIS (U. S. Sales Only).

From Symposium on materials science research; Bangalore, India (24 Feb 1970).

Analysis of x-ray diffraction profiles from cold-worked filings of bcc tantalum–niobium and tantalum–molybdenum alloys (Ta–20, 40, 60, 80 at. % Nb or Mo) as well as pure tantalum and niobium was carried out by Pines and Sirenko method to determine the stacking fault probability in these alloys. In all the alloys studied, the particle sizes in a particular direction were confined to within a fairly narrow range, but were in different directions, showing an anisotropy of the particle size. The strains were also found to be anisotropic. The ratio $D_e(110)/D_e(200)$ as well as the compound fault probability ($1.5\ \alpha + \beta$) appeared to have a maximum value at about 60 at. % tantalum for both the alloy systems. (auth) (INIS)

24594 (IS-T-444) ANALYSIS OF CONVECTION EFFECTS IN CAPILLARY-RESERVOIR DIFFUSION MEASUREMENTS. Zavadoski, Roger William (Ames Lab., Iowa). Feb 1971. Contract W-7405-eng-82. 96p. Dep. NTIS.

XUM

Thesis.

The effects of thresholdless convection on capillary-reservoir diffusion experiments for liquid metals are mathematically modeled and numerically solved. Thresholdless convection is found to be bounded by the two dimensional diffusion equation when no convection is present and by the one dimensional diffusion equation when infinite convection is present. The commonly used average concentration equation, $C = (8/\pi^2) \sum_{n=0}^{\infty} [1/(2n+1)^2] \exp[-(2n+1)^2\pi^2 T/4]$, is found to be applicable when the following constraints are met: the aspect ratio (L/D) is greater than 50; the reservoir to capillary diameter ratio is 25; the reservoir to capillary height ratio is 1; and C is between 0.8 and 0.4. Interdiffusion studies should operate under these restraints. For aspect ratios less than 50 and the remaining conditions above satisfied, the following approximation is applicable for self-diffusion studies: $C = \sum_{n=0}^{\infty} \{2\beta^2/\alpha_n^2[\beta(\beta+1)+\alpha_n^2]\} \exp(-\alpha_n^2 T)$ where α_n are the roots of $\alpha_n \tan(\alpha_n) = \beta$ and $\beta = 2.060202 (L/D)^{1.405883}$. These results take into account the build up of diffusate at the open end of the capillary and hence eliminate the need for stirring. Also, the results are applicable to all liquid systems and are not restricted to liquid metal systems. (auth)

24595 (RFP-1041) PRECIPITATION CHARACTERISTICS OF ROCKY FLATS BERYLLIUM INGOT SHEET. Fraikor, Frederick J.; Grotzky, Virgil K.; Brewer, Arvel W.; Reed, Howard E. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). 12 Mar 1968. Contract AT(29-1)-1106. 25p. Dep. NTIS.

An investigation was conducted, principally by electron-transmission microscopy, of the types, morphology, and behavior of precipitates in typical ingot-sheet beryllium. Specific emphasis was placed on observing precipitation produced by the time and temperature parameters encountered during beryllium sheet production. Depending on the specific heat-treatment history of the beryllium sheet, results showed that the predominant precipitates found in the microstructures were either of the ternary, or of the binary type. In the notations, the symbol M represents one of the transition elements as iron, chromium, nickel, or manganese. The precipitation reactions for beryllium were summarized as a graphic equation. (auth)

24596 INVESTIGATION OF SHORT-RANGE ORDERING IN HIGH-MELTING POINT COMPOUNDS. Umanskii, Ya. S.; Myuller, A. S. Izv. Vyssh. Ucheb. Zaved., Chern. Met.; No. 1, 128-31 (1970). (In Russian).

X-ray diffraction was used to study the short-range ordering in the following alloys: Ti–Ta, TiC–TaC, V–W, VC–WC, TiC–NbC, V–Nb, VC–NbC, and TiC–WC. From the x-ray diffraction intensity curves the characteristics of ordering in these alloys were determined. It was concluded that the C sublattice in the (TiC–NbC) and (VC–WC) alloys was responsible for the change in sign of the energy of mixing and of the short-range coefficient for the first coordination zone. This behavior was observed for the first time. (Metals Abstr.)

24597 NATURE OF THE PHASE INTERACTIONS IN MAGNESIUM ALLOYS OF THE Mg–Nd–Al SYSTEM. Sviderskaya, Z. A.; Padezhnova, E. M. pp 169-80 of Legkie Splavy i Metody ikh Obrabotki. /Drits, M. E. (ed.). Moscow; Izdatel'stvo Nauka (1968). (In Russian).

Three polythermal sections of the Mg–Nd–Al system were studied on the basis of thermal and microstructural analyses of slowly cooled samples. The sections selected for this study are: a section passing through the compositions of binary alloys containing Mg–7% Nd, and Mg–15% Al; a section with a constant content of 80% Mg; and a section with a constant content of 20% Nd. It was found that in equilibrium with a magnesium based solid solution were five intermetallic compounds, two of which, Mg_3Nd and $Mg_{17}Al_{12}$, existed in two binary alloys, respectively, while three other compounds, A, B, and C, were discovered previously. A quasi-binary section α–A with a Nb to Al ratio of 5:2 and a eutectic transformation at 635°C is noted. In the magnesium corner of the Mg–Nd–Al system four nonvariant transformations were ascertained: two of them were of eutectic type at 545 and 435°C, while two were of peritectic type at 630 and 620°C. (auth)

24598 IRREGULAR DEGRADATION OF THE β-PHASE IN THE TITANIUM ALLOY BT15. Novikov, I. I.; Kasparova, O. V.; Pol'kin, I. S. pp 261-7 of Legkie Splavy i Metody ikh Orbrabotki. /Drits, M. E. (ed.). Moscow; Izdatel'stvo Nauka (1968). (In Russian).

The nature of the boundary zones free from degradation of the β phase and effects of thermal treatment on BT15 alloys (containing 3.07 % Al, 6.96% Mo, 10.58% Cr, 0.16 O and traces of other impurities), were studied in the temperature range from 900 to 1100°C. (R.V.J.)

24599 SOLID–LIQUID PHASE EQUILIBRIUM IN THE SODIUM–CAESIUM ALLOY SYSTEM. Ott, J. Bevan; Goates, J. Rex.; Oyler, Dee E. (Brigham Young Univ., Provo, Utah). Trans. Faraday Soc.; 67: 31-4(Jan 1971).

Thermal methods were used to determine with high precision the solid-liquid equilibria diagram for the sodium-cesium system. The results differ greatly from those of earlier workers, especially near the eutectic composition, where differences in melting points as large as 35°K occur. Identification of the phases involved in the peritectic halt was not conclusive, but does support the proposal that the peritectic results from the formation of an Na_2Cs intermetallic compound by a sluggish reaction. (auth) (UK)

24600 EFFECT OF TERNARY ADDITIONS ON THE DECOMPOSITION OF METASTABLE BETA-PHASE TITANIUM ALLOYS. Williams, J. C.; Hickman, B. S.; Leslie, D. H. (North American Rockwell Science Center, Thousand Oaks, Calif.). Met. Trans.; 2: 477-84(Feb 1971).

The effect of ternary additions of Al, O, Sn, and Zr on the decomposition of metastable Ti–Mo and Ti–V β-phase alloys was studied. It was shown that all these additions reduced the volume fraction, upper temperature limit of formation, and time of stability of the ω phase. These results were contrasted to earlier work in binary alloys in which misfit was shown to be a primary factor in determining the morphology and range of stability of the ω phase. In the ternary alloys the particle morphology can still be explained in terms of misfit, but other considerations appear to be predominant in determining the range of stability. Results are also presented on a phase separation reaction which occurred at higher alloy contents and which had an important influence on the morphology of α-phase precipitation. (auth)

24601 EFFECT OF ORIENTATION AND SENSE OF APPLIED UNIAXIAL STRESS ON THE MORPHOLOGY OF COHERENT GAMMA PRIME PRECIPITATES IN STRESS ANNEALED NICKEL-BASE SUPERALLOY CRYSTALS. Tien, J. K.; Copley, S. M. (Pratt and Whitney Aircraft, Middletown, Conn.). Met. Trans.; 2: 543-53(Feb 1971).

The coarsening of coherent γ' [$Ni_3(Al,Ti)$] precipitates in single crystals of a representative nickel-base superalloy, Udimet 700, was shown to be affected by a uniaxial stress applied during annealing. Depending on the sense of the applied stress and its crystallographic orientation, stress annealing resulted in oriented cuboidal, plate, or parallelepiped shaped γ' precipitates. A general thermodynamic analysis of the effect of stress annealing on precipitate morphology is presented that takes into account free energy changes due to changes in bulk precipitation strain, effective modulus, coherency strain energy, and the total interphase boundary area. The analysis correctly predicts the observed γ' precipitate morphologies as a function of stress axis orientation, stress sense, the lattice misfit of the precipitate phase, and the elastic constants of the matrix and precipitate phases. The analysis also showed that stress induced morphological changes could be completely precluded, as may be desired to optimize mechanical behavior, only if the elastic constants of the matrix and precipitate phases were equal. Changes in morphology due to changes in bulk precipitation strain, which in the case of Udimet 700 was shown to be the dominant effect, can be eliminated by alloying for zero lattice misfit or, in single crystals, by stressing parallel to ⟨111⟩. Applications to long-term creep behavior and to the fabrication of composite structures are discussed. (auth)

24602 YTTERBIUM–INDIUM SYSTEM. McMasters, O. D.; Nipper, C. L.; Gschneidner, K. A. Jr. (Ames Lab., Iowa). J. Less-Common Metals; 23: 253-62(Mar 1971).

X-ray diffraction, differential thermal, and metallographic methods were used to establish the ytterbium–indium phase diagram. Eutectic reactions occurred at 690°C and 11.5 at. % In, at 875°C and 63.0 at. % In, and at 154°C and greater than 99 at. % In. An inverted peritectic reaction developed as a result of indium additions, lowering the 792°C transformation temperature of ytterbium to 750°C. The intermetallic compounds, Yb_5In_3, Yb_3In, and $YbIn_3$, decomposed peritectically at 810, 820, and 630°C, respectively. YbIn and $YbIn_2$ melted congruently at 1067 and 890°C, respectively. The crystallographic data for these compounds are given. The relationships among the Yb–, Eu–, Ca–, and Ba–In systems and the valency characteristics of Yb in these alloys are discussed. (auth)

Radiation Effects

Refer also to abstracts 23799, 25164, and 25208.

24603 (COO-1800-11) INCREASE IN THE INTERNAL FRICTION DUE TO ELECTRON IRRADIATION. Simpson,

H. Mitchell; Sosin, A.; Seiffert, S. L. (Utah Univ., Salt Lake City). [1966]. Contract AT(11-1)-1800. 12p. Dep. NTIS.

The effects of electron irradiation on the damping in high purity copper are reported for the temperature range, 78 to 310°K. The results showed an anomalous effect of a peak in the decrement as function of electron dose. This peaking effect can be accounted for in terms of the dislocation dragging radiation-induced point defects. (auth)

24604 (COO-1800-12) NEW MECHANISM FOR INTERNAL FRICTION. Simpson, H. Mitchell; Sosin, A.; Edwards, Gary R. (Utah Univ., Salt Lake City). [1967]. Contract AT(11-1)-1800. 13p. Dep. NTIS.

Simultaneous measurements of damping and elastic modulus of copper as effected by electron irradiation above room temperature were made. These data did not follow the standard analysis, using the Granato-Lucke theory for damping, in which point defects, created by irradiation, are presumed to act as firm pinning points on dislocation lines. It is proposed instead that these defects are dragged along by the dislocation line moving under oscillating stress. (auth)

24605 (COO-1800-15) THERMAL CONVERSION OF INTERSTITIALS IN ELECTRON IRRADIATED COPPER. Simpson, H. M.; Sosin, A.; Seiffert, S. L. (Utah Univ., Salt Lake City). [1970]. Contract AT(11-1)-1800. 18p. Dep. NTIS.

A study by internal friction measurements was made on high-purity copper of the effects of 1-MeV electron irradiation on the rate of addition of point defects to dislocations in the temperature range 78 to 400°K. A distinct minimum in the point defect pinning rate was observed at about 160°K. It was also observed that a peak in the decrement as a function of irradiation time occurred, having a peak position time dependence which reflected the rate at which point defects arrived at dislocations. The above observations are discussed and taken as direct experimental evidence in support of the thermal conversion model. The maximum in internal friction and the minimum in the pinning rate are accounted for in a model of damping due to the dragging of points defects by dislocations. (auth)

24606 (NRL-7176) MAJOR FACTORS AFFECTING NEUTRON IRRADIATION EMBRITTLEMENT OF PRESSURE-VESSEL STEELS AND WELDMENTS. Steele, Lendell E. (Naval Research Lab., Washington, D. C.). 7 Aug 1970. Contract AT(49-5)-2110. 22p. Dep. NTIS.

The major aspects of neutron irradiation embrittlement in steel pressure vessels of large commercial nuclear-power reactors are reviewed. Since neutron radiation may harden and embrittle steels, periodic assessment of the operating reactor vessel ductility is necessary for assuring containment reliability. Embrittlement varies greatly depending on certain factors, including especially the materials, temperature, and neutron environment. Steel variability can be controlled through limitations on residual element content which can yield high resistance to radiation embrittlement. Similarly, welds were produced with high embrittlement resistance. The trend of higher temperatures in more recently produced commercial water reactors is also a positive factor since neutron embrittlement is reduced at elevated temperatures. Other variable factors related to the nuclear and physical environment must be considered also. For the neutron energy spectrum, which varies considerably within a nuclear plant, knowledge is available to permit projection of the damaging potential of a specific neutron spectrum. Applying available knowledge of the several critical factors affecting radiation embrittlement, a preventive approach for minimizing embrittlement has a firm basis for future vessels. For those now in operation or soon to be placed into operation, however, it is necessary that the knowledge of these critical factors be combined with advanced fracture safety approaches in order to maximize the potential for continued vessel reliability in nuclear service. (auth)

24607 BRIGHT SPOT IMAGES IN FIELD ION MICROGRAPHS OF IRRADIATED TUNGSTEN. Buswell, J. T. (Central Electricity Generating Board, Berkeley, Eng.). Phil. Mag.; 23: 293-302(Feb 1971).

An investigation was made of the origin of bright spot images in field ion micrographs of heavy ion, or neutron, irradiated tungsten. Spots were observed in the low field areas in the specimens. After all doses, and with all irradiating species, the concentration of bright spots was similar to the concentration of vacancies in the same specimens. The majority of the spots could not be interpreted in terms of interstitial defects. Rather, they were due to the decoration of vacancy damage, in the low field regions, by an unidentified surface contaminant migrating from the shank of the specimen. There was evidence of glissile interstitial and vacancy dislocation loops. The presence of interstitial loops, after irradiation at ambient temperatures ($\approx 0.1\ T_m$), infers that interstitials are mobile in stage II, in tungsten. Observations on the asymmetry of shape of some spots were considered. (auth) (UK)

24608 ANALYSIS OF THE SIZE DISTRIBUTION INTERSTITIAL CLUSTERS IN IRRADIATED CRYSTALS. Burton, J. J. (Columbia Univ., New York). Phil. Mag.; 23: 485-94(Feb 1971).

The model describing the clustering of interstitials in irradiated crystals which was examined by Brown, Kelly and Mayer (1969) explains many experimental observations but cannot account for the size distribution of the interstitial clusters. Brown, et al. explicitly considered interstitial annihilation with a vacancy, collision of two interstitials to form a di-interstitial, and collision between an interstitial and a cluster of n interstitials to form a cluster of n + 1 interstitials. It is shown that the dissociation of interstitial clusters must be considered, as well as those processes proposed by Brown et al., in order to account for the experimentally observed cluster size distributions. The computed size distributions are quite sensitive to the parameters describing cluster dissociation. (auth) (UK)

24609 NEUTRON IRRADIATION DAMAGE IN MOLYBDENUM. PART I. CHARACTERIZATION OF SMALL PERFECT DISLOCATION LOOPS BY TRANSMISSION ELECTRON MICROSCOPY. Maher, D. M.; Eyre, B. L. (Atomic Energy Research Establishment, Harwell, Eng.). Phil. Mag.; 23: 409-38(Feb 1971).

In order to characterize more completely defect structures typical of high dose neutron irradiation experiments, the determination of perfect dislocation loop geometry, as defined by the direction and sense of the Burgers vector b and the loop plane normal n, is re-examined. The practical aspects of electron diffraction contrast experiments leading to definitions of these vectors are considered. It is shown that the nature of a relatively high proportion of dislocation loops can confidently be assessed. In particular, loops falling into a so-called intermediate size range (100 to 500 Å diameter) can satisfactorily be characterized and thus a situation approached where the experimental techniques of small cluster analysis and large loop analysis are effectively joined. (auth) (UK)

24610 NEUTRON IRRADIATION DAMAGE IN MOLYBDENUM. PART II. THE INFLUENCE OF CRYSTAL PERFECTION AND IRRADIATION TEMPERATURE ON THE DAMAGE STRUCTURE AND ITS ANNEALING BEHAVIOUR. Eyre, B. L.; Maher, D. M.; Bartlett, A. F. (Atomic Energy Research Establishment, Harwell, Eng.). Phil. Mag.; 23: 439-66(Feb 1971).

Molybdenum, ranging in resistivity ratio ($\rho_{293°K}/\rho_{4.2°K}$) from 150 to 8000, was neutron irradiated at 77 and 473°K to integrated fission doses of $\sim 10^{20}$ n.cm^{-2} and $\sim 7 \times 10^{19}$ n.cm^{-2}, respectively. A detailed electron microscope study was made of the damage structures both before and after a post-irradiation anneal of one hour at 1173°K. It was found that the defect cluster topology in the irradiated specimens is a sensitive function of both material purity and irradiation temperature. A model is discussed specifically to explain the topology of interstitial clusters in which impurity assisted nucleation dominates. The microscopy observations indicate that the defect structures which develop as a result of post-irradiation annealing are influenced by crystal purity, but not by irradiation temperature. It is clear that loop growth plays an important role in the development of these structures and that the presence of impurities has an important influence on the extent of growth. Extensive diffraction contrast analysis experiments were carried out to determine the nature of loops in irradiated-annealed materials. The experimental conditions that must be fulfilled to obtain a reliable and consistent answer are defined. The results show that the nature of resolved (111) perfect dislocation loops, and in particular the proportion of vacancy loops surviving an anneal, are significantly influenced by crystal purity, irradiation temperature, and the thermal cycle. Consideration was given to the processes occurring during an anneal which might account for this dependence. (auth) (UK)

24611 ENERGY DEPENDENCE OF NEUTRON RADIATION DAMAGE IN SOLIDS. Robinson, M. T. (Oak Ridge National Lab., Tenn.). pp 364-78 of Nuclear Fusion Reactors. London: Inst. of Civil Engineers (1970).

From International Conference on Nuclear Fusion Reactors, Culham, England. See CONF-690901.

A displacement cascade may be characterized by the "damage energy," i.e., by the kinetic energy of the primary recoil atom, corrected for the energy lost to electron excitation by all the particles comprising the cascade. The damage energy, suitably averaged over the primary recoil spectrum, is an appropriate measure of the dependence of radiation damage on the incident neutron en-

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ergy. Mean damage energies were calculated for 0.1- to 15-MeV neutron irradiation of C, Al, Cu, Nb, and Au, including anisotropic elastic scattering, inelastic scattering and (n,2n) reactions as the sources of primary recoils. Corrections for losses to electron excitation were based on theoretical calculations by Lindhard. In C, the damage energy reaches a maximum near a neutron energy of 1 MeV and falls slowly to about half this value at 15 MeV. In the other elements, the damage rises from 1 to 15 MeV, but by much smaller factors than the energy increase. In Cu, Nb, and Au, correctly accounting for the nuclear reactions is more important than a highly accurate description of electronic losses, but in A and Al, where the primary recoil energies are much higher, electronic energy losses play a more important role. (auth) (UK)

24612 EFFECT OF NEUTRON IRRADIATION ON THERMALLY ACTIVATED DISLOCATION GLIDE IN MILD STEEL. Little, E. A. (Atomic Energy Research Establishment, Harwell, Eng.). Phys. Status Solidi (a); 3: 983-94(16 Dec 1970).

The temperature and strain-rate dependence of the tensile lower yield stress of an aluminum-grain-size-controlled mild steel irradiated to a dose of 2.3×10^{18} n/cm^2 (fission) were investigated in the range 77 to 523°K. Activation enthalpies and activation volumes were evaluated as functions of the effective stress and used to identify the mechanisms controlling deformation. It is observed that below ~300°K, the radiation-induced hardening is temperature-independent, and the activation parameters are consistent with the Peierls process as the operative mechanism; the predictions of the Dorn–Rajnak model are obeyed up to ~195°K. Thermal activation of the radiation damage is detected only above ~300°K, the temperature above which the yield stress of the unirradiated material is temperature-insensitive. The temperature and strain-rate dependence of the radiation hardening are consistent with the theoretical relationships of Fleischer. It is inferred that interstitial clusters are responsible for strengthening and the hardening is caused by the interaction of glide dislocations with their tetragonal strain fields or by direct contact interaction. Calculations indicate that the clusters contributing to strengthening are <10 Å in diameter and spaced ≈40 to 60 Å apart. (auth)

24613 RESISTANCE OF PRECISION ALLOYS TO IRRADIATION. Artsishevskii, M. A. Sb. Tr. Tsent. Nauch.-Issled. Inst. Chern. Met.; No. 71, 69-76(1969). (In Russian).

Changes in the physical properties of alloys caused by irradiation are associated with a change in the structure condition and not with formation of defects (as with pure metals). An examination of experimental data has revealed the relationships involved in the changes in these properties and has made it possible to assess the resistance of a series of alloys to different conditions of irradiation. (Referativnyi Zh.)

Ceramics and Cermets

Refer also to abstract 23758.

Corrosion and Erosion

Refer also to abstract 24531.

24614 (MDC G-2033) PLUTONIA/CURIA COMPATIBILITY TESTING. Quarterly Report No. 9, October–December 1970. Andelin, R. L.; Watrous, J. D. (McDonnell Douglas Astronautics Co., Richland, Wash. Donald W. Douglas Labs.). Jan 1971. Contract AT(45-1)-2138. 16p. Dep. NTIS.

Microhardness measurements reaffirmed previously reported metallographic and electron beam microprobe results for plutonia/refractory metal combinations exposed at 1800 and 2000°C. Curia exposed at 2000°C for 1000 hours is being examined metallographically. Exposure continues at 1800 and 2000°C on plutonia-238/refractory metal, curia-244/refractory metal, and plutonia-molybdenum cermets. Test matrices have been established and materials ordered for more systems-oriented test programs utilizing several plutonia fuel forms in contact with a variety of materials. (auth)

24615 CARBON DEPOSITION FROM ELECTRONICALLY-EXCITED GAS-GRAPHITE OXIDATION REACTIONS IN CLOSED SYSTEMS. Jones, S. S. (Battelle-Northwest, Richland, Wash.). Contract AT(45-1)-1830. Carbon: 8: 685-8(Nov 1970).

An investigation was made of microstructural changes produced in nuclear graphites by electronically-excited gas-oxidation reactions under static conditions. The principal change in the static system which was not found with flowing gases is carbon deposition. The carbon deposits, which appear not to contain suboxides, are of two types, (1) clusters, and (2) tree-like formations. The clusters are random arrays of small crystallites and appear to form in the gas phase and settle out on nearby surfaces. In contrast, the tree-like structures grow on the substrate and consist of larger crystallites oriented with the graphite basal planes at a high angle to the surface. Both carbon gasification and deposition were found in this study. However, deposition occurred only at 900 μ initial oxygen pressure, the highest pressure investigated. Gasification results from oxidation by excited oxygen and carbon dioxide. Deposition processes involve the excited reaction of carbon monoxide to produce carbon clusters directly in the gas phase and carbon growth on the heated substrate from carbon suboxide pyrolysis. Apparently, gasification and deposition can occur simultaneously with the net result being determined by the relative rates of the two processes. (auth) (UK)

24616 METAL OXIDES AS CATALYSTS FOR THE OXIDATION OF GRAPHITE. McKee, Douglas W. (General Electric Co., Schenectady, N. Y.). Carbon: 8: 623-35(Nov 1970).

The oxides of a number of transition metals were studied as catalysts for the oxidation of graphite by dry oxygen. Thermogravimetric analysis was used to measure ignition temperatures of doped polycrystalline graphite and changes in the microtopography of natural graphite crystals during the catalytic oxidation were investigated by optical microscopy. In many cases information on the chemical nature of the catalytic entities could be obtained by oxidizing mixtures of metal acetates and polycrystalline graphite in the thermobalance. Only those oxides which could be reduced by graphite to a lower oxide or to the metallic state appeared to function as active catalysts. The localized action of the catalyst particles gave rise to catalytic channeling and/or the promotion of etch pit formation on the graphite basal plane, depending on the nature of the catalyst. (auth) (UK)

Preparation and Fabrication

Refer also to abstracts 23641, 23777, 24550, and 25239.

24617 (ANL-7671) CONVERSION OF URANIUM DIOXIDE TO URANIUM CARBIDE IN AN INDUCTION PLASMA TORCH REACTOR. Ramaswami, D.; Pavlik, J.; Jonke, A. A. (Argonne National Lab., Ill.). Aug 1970. Contract W-31-109-eng-38. 35p. Dep. NTIS.

Exploratory studies were conducted to determine the feasibility of using an induction plasma torch reactor for converting uranium dioxide-graphite powder agglomerates to uranium carbide spheres. The agglomerates were fed continuously into the tail flame of a 25-kW (4-MHz) induction plasma torch pointed downward. The solid particles were entrained by the tail flame and were directed into a product receiver, where they were separated from the gas stream. About 20% of the particles in the product were shiny (with metallic luster) black spheres of 25 to 50 μm. The remainder of the particles had shapes similar to those of feed particles, with some rounding off of sharp corners. Between 74 and 82% of the carbon in the feed agglomerates was converted to gaseous and solid products (CO, UC, and alpha-UC_2). The percent carbon utilization was almost constant, although the C/U atom ratio in the feed was varied between 1.4 and 3.2, the average particle size of the feed between 58 and 107 μm, and the solid feed rate between 0.06 and 0.9 kg/hr. The results of this exploratory study indicate that the method might be suitable for continuous large-scale production, under critically-safe conditions, of (U,Pu)C fuel for fast breeder reactors. (auth)

24618 (BAW-3714-19) GEL-ADDITION PROCESS CHEMICAL STUDIES. Quarterly Progress Report No. 17, August–October 1970. Carlson, R. V. (comp.) (Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.). Jan 1971. Contract AT(30-1)-3714. 46p. Dep. NTIS.

The development of a sol-gel process and related processes for preparing (U,Pu)O_2 fast reactor fuels has continued. Eighteen fuel pins containing $^{235}UO_2$–20% PuO_2 in the form of pellets, shards, or sol-gel microspheres have passed final inspection for an unencapsulated bundle to be irradiated in the EBR-II. Sufficient coprecipitated powder and sol-gel microspheres for the EBR-II reload pins were prepared. Pellets and shards are being fabricated. Nine capsules irradiated in the BAWTR were disassembled previously. Gas analyses and detailed metallographic examinations of the 27 fuel pins contained in these capsules are in progress in hot cell facilities. (auth)

24619 (DP-Report-431) STUDIES ON THE PREPARATION OF THORIUM/URANIUM DICARBIDE AND THORIA/URANIA FUEL KERNELS BY THE SOL-GEL TECHNIQUE IN THE DRAGON FUEL ELEMENT DEVELOPMENT LABORATORY. Project DRAGON. Podo, L. A.; Horsley, G. W. (Atomic Energy Establishment, Winfrith (England)). May 1966. 65p. Dep. NTIS (U. S. Sales Only).

Sol-gel processes developed in various laboratories for the ultimate production of Th/U dicarbide and thoria/urania spherical fuel particles have been examined and aspects of these combined to produce a flexible and effective sol-gel method for the preparation of oxide and carbide fuel kernels, of controlled porosity, size range and composition for irradiation tests using simple laboratory techniques. The method, the development and operation of which is described in detail, consists of peptizing thorium hydroxide with uranyl nitrate and nitrate ions at 100°C to form a sol in which carbon black is subsequently dispersed: to this material is added hexamethylene tetramine and the mixture formed into droplets which are gelled by the decomposing amine in warm (45°C) 2-ethyl hexanol. Such gelled spheres are then treated in ammonia solution to remove nitrate ion, dried in air and heat treated to form either porous or dense carbide and oxide fuel kernels. Ways of simplifying and improving this method to convert it to a viable production process for a specific fuel and aspects concerned with the refabrication of recycled Th/^{233}U fuel particles by different sol-gel processes are also discussed. (auth)

24620 (DP-Report-441) SAFETY OF OPERATIONS IN THE DRAGON FUEL ELEMENT LABORATORY DURING 1965. Project DRAGON. Batchelor, E. R.; Brooks, C. R.; Eycott, A. J.; Gardham, B.; Holliday, J.; Lewis, R.; Price, M. S. T.; Sinden, R. P.; Sneddon, J. S. ((Atomic Energy Establishment, Winfrith (England)). Jul 1966. 49p. Dep. NTIS (U. S. Sales Only).

Operational safety in the Dragon fuel element production facility is reviewed. Information is included on formal modifications to safety standards and on safety procedures in preparation of fuels. (J.R.D.)

24621 (JUL-687-RW) DEVELOPMENT OF COATED FUEL PARTICLES. REPORT ON THE ROLE OF GERMAN WORK ON THE DEVELOPMENT OF FUEL ELEMENTS FOR HIGH-TEMPERATURE REACTORS. Nickel, H. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorwerkstoffe). Aug 1970. 44p. (In German). Dep. NTIS (U. S. Sales Only).

Studies on coated breeder reactor fuel particles are described. Methods for the preparation of fuel particles were investigated. The techniques for the coating of fuel particles with pyrocarbon and SiC of defined structure and properties were studied. The importance of prismatic laminated bodies in the HTR fuel elements was discussed. The irradiation of model particles showed the radiation damage to the pyrocarbon by fast neutrons. The amoeba effect was also considered. (J.S.R.)

24622 (JUL-703-RW) U(C,N) AS HIGH-EFFICIENCY FUEL PREPARATION AND IRRADIATION PROPERTIES. Khan, I. Ali; Naoumidis, A.; Pott, G. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorwerkstoffe). Oct 1970. 17p. (In German). (CONF-700920-4). Dep. NTIS (U. S. Sales Only).

From International Meeting on Fast Reactor Fuel and Fuel Elements, Karlsruhe, Germany.

Investigations on uranium carbon nitrides as high-efficiency fuel were carried out. These studies included the preparation of the carbon nitrides and their processing to pellets through hot pressing, the compatibility of these mixed crystals with some steels, and a limited irradiation program to obtain data on the in-pile behavior of this fuel under high power. The swelling behavior, the fission gas release, the fuel stability, and the compatibility with the cladding relative to the composition of the fuel and the burn-up were studied in detail. The results of these studies are reported. (tr-auth)

24623 (UJV-2370.M.) CERAMIC FUEL STUDY. THE EFFECT OF THE O/U RATIO ON URANIUM DIOXIDE SINTERING. Progress Report, January 1 - December 1, 1969. Becvar, J.; Klimova, A. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). [nd]. 20p. (In Czech). NTIS (U. S. Sales Only).

A study was performed on the sintering of UO_2 prepared from ammonium polyuranate by hydrogen reduction at temperatures of 500 to 900°C. The UO_2 was sintered under hydrogen at temperatures of 1450, 1550, and 1650°C. The density of the pellets, usually exceeding 95% of the theoretical value, was not affected significantly by the O/U ratio, but pellets made of material with an O/U ratio of from 2.08 to 2.20 were considerably more homogeneous. On sintering under inert gases an activating effect of hyperstoichiometric oxygen was observed. However, owing to the difficulty of excess oxygen removal from sintered pellets, a large-scale application of this technique was problematic. Heating the pellets in Ar and substitution of Ar for hydrogen at temperatures of 1000 and 1350°C resulted in a cracking of the pellets. (INIS)

24624 INITIAL SINTERING KINETICS OF HYPERSTOICHIOMETRIC URANIUM DIOXIDE. Lay, K. W. (General Electric Research and Development Center, Schenectady, N. Y.). J. Amer. Ceram. Soc.; 54: 18-21(Jan 1971).

The initial sintering kinetics of uranium dioxide power compacts were determined as a function of temperature and stoichiometry ($800 < T < 1050$°C, $2.03 < O/U < 2.16$). The O/U values of the starting compacts were held constant throughout the shrinkage measurements to avoid difficulties caused by simultaneous shrinkage and oxidation or reduction. The shrinkage kinetics were interpreted as being controlled by uranium volume diffusion. The calculated diffusion coefficient was $D = 1.3 \times 10^{-6} \exp(-55{,}000/RT)$ cm^2/s when O/U = 2.08. The diffusion coefficient was approximately proportional to the square of the excess O present, with some deviation at higher O/U values. This behavior can be explained by assuming that the U vacancy concentration is a function of the O activity. (auth)

Properties Evaluations

Refer also to abstracts 23582, 23585, 23739, 24557, 24565, 24566, 24571, 24581, 24584, 25228, 25240, 25246, 26021, 26074, and 26075.

24625 (BARC-I-61) LITERATURE SURVEY ON PLUTONIUM BEARING CARBIDE FUELS PROPERTIES AND POTENTIALS OF URANIUM-PLUTONIUM CARBIDES AS FAST REACTOR FUELS. Zope, B. D.; Moorthy, V. K. (Bhabha Atomic Research Centre, Bombay (India)). 1970. 50p. NTIS (U. S. Sales Only).

The properties and potentials of uranium-plutonium carbides as fast reactor fuels are studied and the superiority of carbide fuels over metal and oxide fuels is established. The studies include various aspects such as phase diagrams, compounds, preparation, fabrication and manufacture, properties, compatibility with cladding materials, irradiation behavior and gas release. The potential of UC-PuC for sodium-cooled fast reactors is discussed. An analytical study of carbide fuel element in the Enrico Fermi Fast Breeder Reactor was made and heat transfer, nuclear and preliminary cost studies show that carbide fuels offer the promise of significant reduction in the fuel cycle cost of fast breeder power reactors. The economic potential of high performance (U,Pu) carbide in an LMFBR is also discussed. (INIS)

24626 (KFK-tr-349) ON THE NATURE OF BINDING IN CARBIDES OF REFRACTORY METALS. Gel'd, P. V.; Tskhay, V. A.; Shveykin, G. P. Translated by Rosemarie Corssen (Kernforschungszentrum, Karlsruhe, Ger.), from Tr. Inst. Khim. Nauk, Akad. Nauk SSSR, Ural. Filial; No. 14, 5-17(1967). 27p. (In German). Dep. NTIS (U. S. Sales Only).

A critical review is given of the latest experimental and theoretical data on the nature of binding in carbides of refractory metals. 57 references. (J.S.R.)

24627 (LIB/Trans-346) CHANGE IN THE THERMAL CONDUCTIVITY IN AN OXIDE FUEL DURING BURNUP. Kleykamp, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material- und Festkoerperforschung). Translated by I. A. Mumme (Australian Atomic Energy Commission Research Establishment, Lucas Heights), from report KFK-1245. 10p. Dep. NTIS (U. S. Sales Only).

An abstract of this report, prepared from the original, appeared as NSA 25: 4839. (Australia)

24628 (N-71-10740) THERMODYNAMIC PROPERTIES OF TERNARY REFRACTORY CARBIDES. PART I. ZIRCONIUM-NIOBIUM-CARBON. Technical Report, July 1, 1967-June 30, 1969. Jun, C. K.; Hoch, Michael (Cincinnati Univ., Ohio). Jun 1969. Contract F33615-67-C-1565. 45p. (NASA-CR-111123; AFML-TR-69-209(Pt.1)). NTIS.

The nonstoichiometry of zirconium-niobium-carbide with the sodium chloride-type structure, $Zr(x)Nb(1-x)C(y)$, was studied by measuring the activities of the components as a function of composition. The samples were prepared by heating the required amounts of oxides and graphite in a high vacuum induction furnace. Lattice parameters were measured of all specimens. At constant carbon concentration (y = constant), the lattice parameter deviated from Vegard's law at the niobium-rich end. The metal-metal interaction energy was not much different from that in the bcc metallic zirconium-niobium system. The difference be-

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tween the zirconium-carbon and niobium-carbon interaction energies [E(13) − E(23)] was linearly dependent on composition. (auth) (STAR)

24629 (NYO–3991-7) NONLINEAR ELASTIC AND THERMOELASTIC PROPERTIES OF HIGH TEMPERATURE MATERIALS. Annual Progress Report. Barsch, G. R. (Pennsylvania State Univ., University Park). Dec 1970. Contract AT(30-1)-3991. 9p. Dep. NTIS.

Measurements for a complete set of third order elastic constants for UO_2 at 300°K were completed. The temperature dependence of the nonlinear pressure dependence of the elastic constants of V_3Ge between 77 and 300°K was determined. The pressure dependence of the elastic constants of wurtzite at 300°K was measured. Progress was also made in the theoretical work on the interpretation of the experimental data in terms of atomistic models, and in their application to the explanation of anharmonic materials properties, ranging from the strain dependence of phonon frequencies to the pressure dependence of the Grueneisen parameter and the temperature dependence of the elastic constants, both on the basis of the anisotropic elastic continuum model and from lattice dynamics. The experimental capability has been strengthened considerably. The cryostat and high-pressure equipment for measuring the pressure dependence of the elastic constants between 4 and 300°K became operational and was in good working condition. A 15-kbar pressure vessel was delivered and will permit the work on the pressure dependence of the third order elastic constants that was interrupted by the loss of a similar pressure vessel through an explosion in 1968 to be continued. Technical difficulties have delayed work with a new 30 to 40 kbar oil press that was added in 1969, but it is expected that it will become operational soon. (auth)

24630 (ORNL–4478) THEORY OF A TIME-DEPENDENT HEAT DIFFUSION DETERMINATION OF THERMAL DIFFUSIVITIES WITH A SINGLE TEMPERATURE MEASUREMENT. Perez, R. B.; Carroll, R. M.; Sisman, O. (Oak Ridge National Lab., Tenn.). Feb 1971. Contract W-7405-eng-26. 25p. Dep. NTIS.

A method to measure the thermal diffusivity of reactor fuels during irradiation was developed, based on a time-dependent heat diffusion equation. With this technique the temperature was measured at only one point in the fuel specimen. This method had the advantage that it was not necessary to know the heat generation (a difficult evaluation during irradiation). The theory included realistic boundary conditions, applicable to actual experimental systems. The parameters were the time constants associated with the first two time modes in the temperature-vs-time curve resulting from a step change in heat input to the specimen. With the time constants and the necessary material properties and dimensions of the specimen and specimen holder, the thermal diffusivity of the specimen can be calculated. (auth)

24631 PRINCIPLES AND LATEST DEVELOPMENTS IN THE FIELD OF METALLIC AND NONMETALLIC HARD MATERIALS. Kieffer, Richard; Ettmayer, Peter (Technische Hochschule, Vienna). Angew. Chem. Int. Ed. Engl.; 9: 926-36(Dec 1970).

A survey of some fundamental aspects of the theory of hardness is followed by a discussion of recent developments in the field of sintered hard metal alloys. For example, good results were obtained by the addition of hafnium carbide to hard metals. Niobium carbide can sometimes replace the more expensive tantalum carbide; vanadium carbide can be used to inhibit grain growth, especially in the case of ultrafine carbides. A brief outline is given of the results of investigations on ternary and quaternary systems with the components TiC, HfC, NbC, TaC, and WC. The utilization of sintered nitride and carbonitride hard metals in the field of machining appears feasible. Recently developed high-pressure high-temperature autoclaves permit work on nitride systems under a high nitrogen pressure. Comments are given on the latest work in the field of nonmetallic hard materials and on diamond synthesis. (auth)

24632 MECHANICAL BEHAVIOR OF ARTIFICIAL GRAPHITES AS PORTRAYED BY UNIAXIAL TESTS. Greenstreet, W. L.; Smith, J. E.; Yahr, G. T.; Valachovic, R. S. (Oak Ridge National Lab., Tenn.). Carbon; 8: 649-63(Nov 1970).

Stress-strain behaviors which are representative of nuclear-grade, or equivalent, graphites are described and discussed. Since cyclic loading test results provide important insight into the characteristics of graphite behavior, emphasis is placed on results of this type. Monotonic loading curves are also considered, and both stress versus longitudinal strain and stress versus lateral strain curves are given for monotonic and cyclic loading. The new results are combined with results published in the literature to provide a unified description of the observed behavior. (auth) (UK)

24633 ELECTRON MICROSCOPE EXAMINATION OF MATRIX FISSION-GAS BUBBLES IN IRRADIATED URANIUM DIOXIDE. Cornell, R. M. (Central Electricity Generating Board, Berkeley, Eng.). J. Nucl. Mater.; 38: 319-28(Mar 1971).

Uranium dioxide irradiated over a wide temperature range to a dose of greater than $\sim 3.2 \times 10^{16}$ fissions/mm^3 was always found to contain a high concentration of intragranular fission-gas bubbles which contained a constant amount of gas approximately independent of both irradiation temperature and burn-up. These bubbles, which are assumed to be nucleated heterogeneously upon the sites of the energetic fission fragments, have a lifetime which lies in the range of 4 to 40 hr with thermal neutron fluxes of $\sim 5 \times 10^{11}$ n/mm^2 · sec. The collection of fission-gas at grain boundaries was controlled by resolution and atomic diffusion of gas atoms through the uranium dioxide lattice rather than by the migration of bubbles up the temperature gradient. The diffusion coefficient of the fission-gas atoms in irradiated uranium dioxide was shown to be considerably enhanced at temperatures below ~1300°C. (auth)

24634 INTERACTION BETWEEN NIOBIUM CARBIDE AND MOLYBDENUM OXIDE. Kolchin, O. P.; Filipenko, V. V.; Buzina, O. T. Tr. Inst. Khim., Akad. Nauk SSSR, Ural. Filial; No. 17, 38-43(1970). (In Russian).

An interaction between NbC and MoO_3 resulting in the production of the elemental metals (Nb and Mo) together with gaseous products (CO and CO_2) is described. The onset of the reaction took place between 480 and 500°C. The precise phase composition of the products depended on the reaction temperature, the amount of gas, for example, increasing as temperature rise to 1100°C. The reduction mechanism involved was based on the evaporation of the MoO_3, and intermediate stages before the formation of metallic Mo includes the formation of intermediate oxides and carbides. (Metals Abstr.)

24635 URANIUM MONONITRIDE: HEAT CAPACITY AND THERMAL CONDUCTIVITY FROM 298 TO 1000°K. Takahashi, Y.; Murabayashi, M.; Akimoto, Y.; Mukaibo, T. (Tokyo Univ.). J. Nucl. Mater.; 38: 303-8(Mar 1971).

The heat capacity and the thermal diffusivity of uranium mononitride were measured by a laser flash method at temperatures ranging from 298 to 1000°K. The samples were arc-melted UN having nearly zero porosity and sintered UN having porosity of 10.1%. The heat capacity of UN was represented by $C_p = 12.08 + 2.548 \times 10^{-3}T - 1.252 \times 10^5 T^{-2}$ cal/mole °K (298 to 1000 °K). From the heat capacity data, entropy, enthalpy and the Gibbs energy function of UN were calculated. The thermal conductivities of arc-melted UN, calculated from the heat capacity and thermal diffusivity data, at 350 and 1000 °K were 0.031 and 0.045 cal/cm · sec · deg. K, respectively. The results agreed reasonably well with those of Moore et al. obtained at lower temperatures. (auth)

24636 CARBON MONOXIDE EQUILIBRIUM PRESSURES AND PHASE RELATIONS DURING THE CARBOTHERMIC REDUCTION OF URANIUM DIOXIDE. Hennecke, J. F. A.; Scherff, H. L. (CCR–EURATOM, Ispra, Italy). J. Nucl. Mater.; 38: 285-91(Mar 1971).

The carbothermic reduction of uranium dioxide was re-investigated and the CO-equilibrium pressures of the different reactions, including equilibria involving the sesquicarbide phase, were determined. From these measurements it resulted that the direct formation of the sesquicarbide was thermodynamically not possible under the reaction conditions usually chosen for carbide preparation. It followed furthermore, that within the temperature range investigated (1600 to 1800°K) the sesquicarbide in equilibrium with free carbon was more stable than the dicarbide phase. (auth)

24637 THORIUM DIFFUSION IN SINGLE CRYSTAL ThO_2. King, A. D. (Atomic Energy of Canada, Ltd., Chalk River, Ont.). J. Nucl. Mater.; 38: 347-9(Mar 1971).

A precision sectioning technique was developed and applied to the measurement of ^{228}Th diffusion in arc-fused single crystals of ThO_2, in the temperature range 1850 to 2050°C. The technique allows the determination of diffusion distances ($2\sqrt{Dt}$, where D is the diffusion coefficient) as small as 0.04 μm. The profiles were confirmed by measurements using the α-spectrum degradation technique). (auth)

24638 THERMAL CREEP OF UO_2 AND UO_2–PuO_2 AT HIGH TEMPERATURES. Kummerer, K.; Vollath, D. (Kernforschungszentrum, Karlsruhe, Ger.). Atomwirt., Atomtech.; 16: 29-31 (Jan 1971). (In German).

Compressive creep of UO_2 and UO_2–PuO_2 samples was studied

at stresses up to 5 kg/mm² and at temperatures from 800 to 2000°C. Creep rate was significantly higher in UO_2-PuO_2 as compared to UO_2 samples. To describe the effects, a mathematical formula was developed and presented. (H.B.G.)

24639 FRACTURE ENERGY OF Al_2O_3 CONTAINING Mo FIBERS. Simpson, L. A.; Wasylyshyn, A. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). J. Amer. Ceram. Soc.; 54: 56-7 (Jan 1971).

The possibility of improving the fracture toughness of Al_2O_3 by incorporating Mo fibers was investigated. Chopped Mo wire was hot-pressed into Al_2O_3 bars with the fibers preferentially aligned perpendicular to the pressing direction. The fracture energy increased approximately linearly with fiber content; at 12 vol % fiber content, it was about 250 times as large as that for pure Al_2O_3. (G.M.C.)

24640 SWELLING CONTROL IN URANIUM CARBIDE. Ervin, Guy Jr. (Atomics International, Canoga Park, Calif.). Contract AT(04-3)-701. J. Amer. Ceram. Soc.; 54: 46-50(Jan 1971).

Fine particles were dispersed in a fuel structure to trap fission gases as very small bubbles and thereby reduce fuel swelling. The dispersions were made by adding 1.5 to 3.0 wt% W to the UC; the specimens were irradiated to a maximum of ≈2 at.% burnup. Density changes were used as the measure of swelling; there was much scatter in the results. Tungsten reduced the swelling when it was uniformly dispersed. For some samples having excess U and W or a segregated structure, W increased the swelling. The results tentatively confirm that fine particles are of value in reducing fission-gas swelling of carbide fuels. (auth)

24641 THERMAL CONDUCTIVITY OF NEARLY STOICHIOMETRIC SINGLE-CRYSTAL AND POLYCRYSTALLINE UO_2. Moore, J. P.; McElroy, D. L. (Oak Ridge National Lab., Tenn.). J. Amer. Ceram. Soc.; 54: 40-6(Jan 1971).

The thermal conductivities, λ, of single crystal and polycrystalline UO_2 were measured from 80 to 420°K. The results indicated no observable difference in λ between single crystal and polycrystalline UO_2, and both materials had broad peaks in λ at ≈220°K. The results were used with literature values to determine the effect of closed porosity on λ. The thermal conductivity of theoretically dense UO_2 is described phenomenologically from 80 to 1400°K, where conduction is dominated by the phonon component. The phonon conduction was analyzed by comparison with ThO_2. This analysis indicated that the high-temperature λ was limited by 3-phonon Umklapp scattering processes. Scattering by the disordered spins associated with the paramagnetic U ions contributed a large temperature-independent phonon scattering term. This mechanism had a mean free path of about 51 Å, which implied that grain boundaries and impurities have a relatively insignificant effect on the phonon conduction far above the antiferromagnetic-paramagnetic transition at ≈30°K. This implication agreed with the experimental results. (auth)

24642 ISOTHERMAL ELASTIC MODULUS OF THE UO_2–SiO_2 SYSTEM. Cojocaru, L. N. (Inst. for Atomic Physics, Bucharest). Phys. Status Solidi (a); 4: K131-4(16 Feb 1971).

The elastic modulus was measured at 25 to 500°C for UO_2-SiO_2 vitroceramics. The 25°C value (6.3×10^5 bar) is between the values for SiO_2 (3.1×10^5) and UO_2 (17.6×10^5), in agreement with the model representing the mixture as a series electrical circuit. The modulus for UO_2-SiO_2 decreases very rapidly with temperature (0.34 bar/degree), much more so than for UO_2 or SiO_2. (D.L.C.)

24643 REACTION OF SELECTED LANTHANIDE CARBIDES WITH PLATINUM AND IRIDIUM. Krikorian, N. H. (Los Alamos Scientific Lab., N. Mex.). J. Less-Common Metals; 23: 271-9 (Mar 1971).

The dicarbides of yttrium, cerium, and erbium reacted with platinum and iridium upon heating in the range 1000 to 1600°C. The reduction of the carbides led to the formation of a number of rare-earth platinides and iridides and free carbon. No ternary compounds were found. Ternary diagrams were deduced. From the reactions, lower limits can be set for free energy of formation of the intermetallic compounds. (auth)

Structure and Phase Studies

Refer also to abstracts 24596 and 25235.

24644 (COO-1198-796) PHASE TRANSFORMATIONS INVOLVING INTERSTITIAL ORDERING IN THE VANADIUM–NITROGEN SYSTEM. Potter, Donald Irwin (Illinois Univ., Urbana). Feb 1971. Contract AT(11-1)-1198. 186p. Dep. NTIS.

Alloys of vanadium containing up to 14.0 atomic percent nitrogen were examined in the as-quenched and aged conditions. X-ray diffraction showed the room temperature material to be body centered cubic for nitrogen contents of less than 6.9% and body centered tetragonal for nitrogen contents greater than 7.4%. Electrical resistivity, measured during quenching, also indicated a change in behavior near 6.0% nitrogen. Transmission electron microscopy was used to follow the progress of aging in alloys containing less than 6.0% nitrogen. When aged, these alloys contained a disc shaped precipitate whose habit plane was determined to be {100}. The matrix remained cubic and the interstitial nitrogen atoms in the matrix were not ordered. The structure of the precipitate was determined from selected area diffraction patterns and consisted of an ordered array of nitrogen atoms in a body centered tetragonal vanadium sublattice. The unit cell of the superlattice, i.e., vanadium sublattice plus nitrogen sublattice, enclosed sixteen vanadium sublattice cells, being 4 × 4 × 1 such cells. The nitrogen sublattice was found to be base centered orthorhombic with c = 3.035Å, b = 12.504Å, and a = 12.140Å. The superlattice cell, which was enclosed by the nitrogen sublattice cell, had these same lattice constants. Stoichiometrically the compound corresponded to $V_{16}N$. It is shown that the nitrogen atoms occupy octahedral interstitial sites rather than the tetrahedral sites predicted from theoretical considerations. Alloys containing greater than 6.0% nitrogen transformed to a banded structure during radiation quenching. The vanadium sublattice showed tetragonal distortion with (c/a) varying from 0.974 in a 7.4% alloy to 0.955 in a 10.0% alloy. X-ray Laue patterns together with two surface analysis showed that adjacent bands were twin related across {110} twin planes, which were the boundaries between bands. There was a fine banding (~100Å) within the main bands. This occurred on the other set of {110} twin planes of the tetragonal system as well as the remaining {110} planes which are not twin planes in the tetragonal system. Electron diffraction showed that the nitrogen atoms in this structure were ordered. A macroscopic shape change as well as audible clicking accompanied the transformation in alloys containing between 6.0% and 8.0% nitrogen. (auth)

24645 (KFK-1297) PHASE EQUILIBRIUM IN THE SYSTEMS ThO_2-UO_{2+x}, CeO_2-UO_{2+x}, AND NpO_2-UO_{2+x}. Paul, Robert (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Radiochemie). Oct 1970. 78p. (In German). Dep. NTIS (U. S. Sales Only).

The study of the phase diagram of the ternary systems Th–U–O for the region $ThO_2-UO_2-U_3O_8$ between 1100 and 1550°C was undertaken by means of chemical analysis and x-ray investigations, as well as metallographic and spectroscopic techniques. Up to 1100°C the following phases were obtained: a two-phase region consisting of orthorhombic β-U_3O_8 and cubic U_4O_9, the phase width being temperature dependent and reaching 45 mole% ThO_2 at 1100°C; the $(Th_nU_{1-n})_4O_9$-phase ($n \leq 0.5$) with a superstructure of the U_4O_9-type; a two-phase region, in which M_4O_9 (M = Th + U) and MO_{2+x} ($x \approx 0.12 - 0.14$, dependent on the composition) coexisted; and a fluorite phase (MO_{2+x}), extending all over the composition range. Above 1100°C the two-phase region (β-U_3O_8 and M_4O_9) extended from pure β-U_3O_8 at 1550°C up to 36 mole% ThO_2, at 1250°C up to 43 mole% ThO_2. (The cubic M_4O_9-phase with a superstructure did not exist in this temperature range.) These phases were followed by the MO_{2+x}-phase over the whole range. The quasibinary systems MO_2-UO_{2+x} (M = Th,Ce,Np) showed significant similarities. The phase width increased with rising temperature, in case of ThO_2-UO_{2+x} it extended over the range 43 to 100 mole% ThO_2 at 1250°C and 36 to 100 mole% at 1550°C. The phase width of the fluorite phase in the NpO_2-UO_{2+x} system showed the greatest temperature dependence (1100°C: 65 to 100 mole% NpO_2; 1550°C: 19 to 100 mole% NpO_2). No solubility for ThO_2 and CeO_2 in β-U_3O_8 was observed. In the system NpO_2-UO_{2+x} a solubility of NpO_2 (3 mole% at 1400°C) in β-U_3O_8 was determined. A significant similarity of the systems MO_2-UO_{2+x} (M = Th,Ce,Np) compared with the system PuO_2-UO_{2+x} is obvious. (auth)

24646 PROPERTY CHANGE OF THE UO_2 CRYSTALLITE IN A SOL-GEL PROCESS. Muto, T.; Tsuboya, T.; Yokosawa, N.; Murase, T. (Power Reactor and Nuclear Fuel Development Corp., Tokai, Japan). J. Nucl. Mater.; 38: 267-84(Mar 1971).

Change in the crystalline properties of sol-gel UO_2 derived from uranous chloride solution was studied. A correlation analysis revealed that larger crystallites in the early stage of the process gave higher sintered densities. The UO_2 crystallite growth during the process can be formulated by the third power equation. $D^3 - D_0^3 = kt$ in principle for both aging of sol and firing of dried gel. The growth during aging was affected strongly by the hexavalent uranium concentration in the solution. The high sinterability of the

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sol-gel UO_2 can be attributed to the closely compacted texture of the dried gel in which pores with diameter larger than 200 Å were essentially lacking and its highly active character of small UO_2 crystallites with the larger lattice defects caused mainly by the substitution of chlorine for oxygen. (auth)

24647 DISCUSSION OF THE REPLY OF MESSRS. ROY AND DAVID TO THE NOTE OF MESSRS. P. LACOMBE, G. BERANGER, P. BOISOT, AND R. PENELLE. Lacombe, P.; Beranger, G.; Boisot, P.; Penelle, R. (Centre de Recherches Metallurgiques, Paris). J. Nucl. Mater.; 38: 346(Mar 1971). (In French).

A reply is given to Roy and David [J. Nucl. Mater., 38: 344-5 (1971)] concerning their rebuttal on a paper dealing with x-ray diffraction analyses of zirconia films on zirconium and Zircaloy-2 (previously published and abstracted in NSA as 24: 51225). (G.M.C.)

24648 AUTHOR'S REPLY TO NOTE BY P. LACOMBE, G. BERANGER, P. BOISOT, AND R. PENELLE. Roy, C.; David, G. (Univ. of Western Ontario, London). J. Nucl. Mater.; 38: 344-5(Mar 1971).

A rebuttal is given to Lacombe et al. [J. Nucl. Mater., 38: 343 (1971)] concerning their comments on a paper dealing with x-ray diffraction analyses of zirconia films on zirconium and Zircaloy-2 (previously published and abstracted in NSA as 24: 51225). (G.M.C.)

24649 DISCUSSION OF X-RAY DIFFRACTION ANALYSES OF ZIRCONIA FILMS ON ZIRCONIUM AND ZIRCALOY-2. Lacombe, P.; Beranger, G.; Boisot, P.; Penelle, R. (Centre de Recherches Metallurgiques, Paris). J. Nucl. Mater.; 38: 343 (Mar 1971). (In French).

Comments are given on a paper published previously concerning x-ray diffraction analyses of zirconia films on zirconium and Zircaloy-2. The paper was abstracted in NSA as 24: 51225. (G.M.C.)

24650 STUDY OF THE GROWTH OF OXIDE ON ZIRCONIUM AND ZIRCALOY-2. David, G.; Geschier, R.; Roy, C. (Univ. of Western Ontario, London). J. Nucl. Mater.; 38: 329-39(Mar 1971). (In French).

The oxidation of polycrystalline zirconium and Zircaloy-2 specimens was followed in situ at 500°C on an x-ray diffractometer fitted with a high temperature chamber. The x-ray traces obtained during oxidation revealed a tendency for the oxide crystallites to adopt a preferred orientation about a fiber-axis when the stresses built up at the metal oxide interface rise. Further, the faces of zirconium single crystals were polished parallel to the (0001), $(10\bar{1}2)$, $(11\bar{2}0)$, and the $(10\bar{1}0)$ planes. The orientations of the crystallites in oxide films of various thicknesses were determined. Initially the epitaxial relationships seemed to prevail; then a fiber texture akin to that found with the polycrystalline specimens became apparent. The higher the mean stress level, the more pronounced was the fiber texture. (auth)

24651 NEW HIGH-PRESSURE PHASE TRANSFORMATIONS IN RARE EARTH AND ACTINIDE CARBIDE SYSTEMS. Krupka, M. C.; Bowman, M. G. (Los Alamos Scientific Lab., N. Mex.). pp 409-14 of Les Proprietes Physiques des Solides Sous Pression. Paris; Centre National de la Recherche Scientifique (1970).

From International Conference on the Physical Properties of Solids Under Pressure, Grenoble, France. See CONF-690908.

Investigations were made of rare earth, including yttrium and scandium, and actinide carbide systems over selected composition regions. New phases synthesized include: yttrium–thorium sesquicarbide, a high-temperature superconductor with a maximum transition temperature of 17°K; yttrium–transition-metal (Ti, Zr, Mo, W) sesquicarbides, superconductors to ~15°K; pure thorium sesquicarbide, Th_2C_3; a new crystal form of Er_2C_3. A pressure-induced acceleration of the kinetics of formation above those of normal annealing methods was observed for several other new phases including low-symmetry forms of DyC_2, TbC_2, and YC_2 as well as body-centered-cubic forms of Lu_4C_3 and Sc_4C_3. (auth) (France)

24652 INTERPRETATION OF X-RAY EMISSION AND ABSORPTION SPECTRA OF BORON IN H_3BO_3, B_2O_3, AND BN. Nakhmanson, M. S.; Baranovskii, V. I. (Leningrad State Univ.). Sov. Phys.-Solid State (Engl. Transl.); 12: 1966-7(Feb 1971).

Translated from Fiz. Tverd. Tela; 12: 2458-9(Aug 1970).

The molecular orbital method is used to calculate the electronic structure of the atomic groups in the environment of a boron atom in H_3BO_3, B_2O_3, and BN. In some cases, the second coordination sphere is taken into account. The results are used to interpret the K absorption and emission spectra of boron in B_2O_3 and BN. It is concluded that the molecular orbital method is satisfactory for B_2O_3 but only qualitative for BN. (D.L.C.)

24653 RELATIONSHIP BETWEEN STRUCTURE AND SPUTTERING PARAMETERS IN NbN FILMS. Alessandrini, E. I.; Sadagopan, V.; Laibowitz, R. B. (IBM Watson Research Center, Yorktown Heights, N. Y.). J. Vac. Sci. Technol.; 8: 188-91(Jan-Feb 1971).

From 17th National Meeting of the American Vacuum Society, Washington, D. C. See CONF-701011.

The structure of thin films of niobium nitrides was examined by reflection electron diffraction techniques. The nitride films were obtained by reactive rf sputtering of the niobium at different power levels and partial pressures of nitrogen. The films were deposited on oriented sapphire substrates maintained either at room temperature or at 400°C. Crystal structures of three distinct phases were observed and identified as (1) α-bcc niobium with nitrogen in solid solution, (2) β-hexagonal Nb_2N, and (3) δ-fcc NbN. In this study, the γ-Nb_4N_3 composition could not be obtained as a single phase but was always found to occur as a mixture with the δ phase. The films prepared at both high partial pressures of nitrogen and rf powers had strong textures that were dependent also on the film thickness. The electron-diffraction data showed that niobium nitride films with successive structure transformations similar to that in the bulk state can be realized and that the transformations can be correlated to the sputtering parameters used. (auth)

24654 INFLUENCE OF REDUCTION ON ESTIMATION OF THE ZrO_2 TETRAGONAL-CUBIC TRANSFORMATION TEMPERATURE. Nicholson, Patrick S. (McMaster Univ., Hamilton, Ont.). J. Amer. Ceram. Soc.; 54: 52-3(Jan 1971).

The effects of the possible reduction of ZrO_2 in high-temperature x-ray investigations on discrepancies in the measured tetragonal-cubic transformation temperature values are discussed. The probable phase relation existing under the experimental conditions was described by extrapolating thermodynamic data from lower temperatures. (G.M.C.)

24655 PHASE EQUILIBRIA AND PHYSICAL PROPERTIES OF OXYGEN-DEFICIENT ZIRCONIA AND THORIA. Carniglia, S. C. (Kaiser Aluminum and Chemical Corp., Pleasanton, Calif.); Brown, S. D.; Schroeder, T. F. J. Amer. Ceram. Soc.; 54: 13-17(Jan 1971).

The compositions of anion-deficient zirconia and thoria in equilibrium with O_2 were measured from 1 to 10^{-6} atm and 1400 to 1900°C; for ZrO_{2-x} (p_{O_2} in atm, and T in °K), $\log x \cong -0.890 - [(0.400 \times 10')/T] - [(\log p)/6]$; for ThO_{2-x}, $\log x \cong -1.870 - [(0.340 \times 10')/T] - [(\log p)/6]$. The ZrO_{2-x}-Zr boundary was located at x = 0.014 at 1800°C; thoria was single-phase over the entire range. Consistent results were obtained when O_2/inert gas mixtures were used, but use of H_2/H_2O and CO/CO_2 at 1000 to 1200°C gave abnormal and, in the latter case, erratic data; side reactions in these atmospheres are inferred. The monoclinic-tetragonal phase change of ZrO_2 and the lattice thermal expansion, room-temperature Young's modulus, and strength properties of ZrO_2 and ThO_2 bodies were not appreciably altered by oxygen deficiency. The lattice dimensions decreased slightly with departure from stoichiometry. (auth)

24656 X-RAY AND NEUTRON DIFFRACTION STUDY ON A PHASE TRANSITION IN THE U_4O_9 PHASE. Ishii, Tamotsu (Tokyo Univ.); Naito, Keiji; Oshima, Keichi; Hamaguchi, Yoshikazu. J. Phys. Chem. Solids; 32: 235-41(Jan 1971).

A neutron and x ray diffraction study was made on the phase transition of U_4O_9 and U_4O_{9-y} which occurs at a region slightly above room temperature. On the basis of the neutron data of the fluorite-type reflections, and the x ray diffraction data of the superlattice lines, the behavior of oxygen atoms during the transition is discussed. In U_4O_{9-y}, the vacancies in the fluorite oxygen sites increase at the transition when it is approached from the low-temperature side. Above the transition temperature some portions of the lattice oxygen atoms leave the lattice sites and enter into the interstitial positions. These interstitial oxygen atoms contribute to intensify the superlattice lines. (auth) (UK)

24657 GRAIN REFINEMENT IN ALUMINUM ALLOYED WITH TITANIUM AND BORON. Marcantonio, J. A.; Mondolfo, L. F. (Revere Copper and Brass, Inc., Rome, N. Y.). Met. Trans.; 2: 465-71(Feb 1971).

The aluminum corner of the ternary Al-B-Ti diagram was explored. A eutectic: Liq $\rightarrow$ Al + $TiAl_3$ + (Al, Ti)B_2 was found at approximately 0.05 wt % Ti, 0.01 wt % B; 659.5°C. TiB_2 and AlB_2 formed a continuous series of solid solutions, but no distinct ternary phase was found. The addition of boron to aluminum-titanium alloys expands the field of primary crystallization of $TiAl_3$ toward lower titanium contents and steepens the liquidus. In equilibrium conditions, pronounced grain refinement was found only in alloys in which $TiAl_3$ was primary and nucleated the aluminum solid solution before any other impurity could act. The peritectic reaction

facilitated this priority but it was not necessary for grain refinement. Because of the low diffusivity of titanium and boron in aluminum, equilibrium is seldom attained and in commercial practice grain refinement by $TiAl_3$ is found also outside its equilibrium field of primary crystallization. (auth)

24658 SYMPOSIUM ON HOMOGENIZATION OF ALLOYS, LAS VEGAS, NEVADA, MAY 1970. Met. Trans.; 2: 357-432 (Feb 1971). (CONF-700553).

A total of 7 papers were presented at the symposium. A separate abstract was prepared for 1 paper. The remaining 6 papers were not within the scope of NSA. (G.M.C.)

For an abstract of an individual paper see: 24659.

24659 SECOND PHASE DISSOLUTION. Aaron, Howard B.; Kotler, Gerald D. (Ford Motor Co., Dearborn, Mich.). Met. Trans.; 2: 393-408(Feb 1971).

From Symposium on Homogenization of Alloys, Las Vegas, Nev. See CONF-700553.

A detailed theoretical study was made of the dissolution of precipitates. The kinetic analyses of the atomic mechanisms included the concurrent effects of diffusion, interface reaction, and curvature, and considered the more complex problems of precipitate arrays and nondepleted matrices. The general formalism thus obtained was used to interpret the results of an experimental investigation of the technologically important problem of the dissolution of reluctantly soluble carbides in the Fe–C–V system. It was found that vanadium carbide (and iron carbide as well) were quite easily dissolved while complex alloy sulfides, silicates, and oxides (possibly associated with the presence of vanadium) persisted, with little if any dissolution. Previous views of the reasons for poor hardenability were reevaluated in light of these results. (auth)

24660 STRUCTURE AND ELECTRICAL PROPERTIES OF NONSTOICHIOMETRIC SINGLE CRYSTALS OF VANADIUM SESQUIOXIDE V_2O_3. Novikov, V. N.; Tallerchik, B. A.; Gindin, E. I.; Prokhvatilov, V. G. Sov. Phys.-Solid State (Engl. Transl.); 12: 2061-4(Mar 1971).

Translated from Fiz. Tverd. Tela; 12: 2565-9(Sep 1970).

The electrical properties and crystal structure of single crystals of vanadium sesquioxide V_2O_3, grown by the Verneuil method, were investigated. It was determined that a crystallographic transition does not occur at about −130°C in nonstoichiometric single crystals with composition $V_2O_{3.020}$–$V_2O_{3.030}$. The electrical conductivity of such single crystals in the temperature range +600 to −185°C has a metallic character. The properties of stoichiometric single crystals of V_2O_3 agree with data published earlier. The results obtained confirm the electronic character of the metal–semiconductor transition in stoichiometric vanadium sesquioxide. (auth)

24661 PREPARATION AND CRYSTALLOGRAPHIC CHARACTERIZATION OF TWO NEW TYPES OF TERNARY METAL HYDRIDES. Van Houten, Robert; Bartram, Stanley (General Electric Co., Cincinnati). Met. Trans.; 2: 527-30(Feb 1971).

Ternary metal hydrides of thorium with zirconium or titanium were recently prepared and identified. One of these compounds, $ThZr_2H_{7\pm x}$, had the cubic C15 type of structure. This hydride showed a high hydrogen density, e.g., 6.7 to 7.7 × 10^{22} hydrogen atoms per cm^3 (i.e., N_H 6.7 to 7.7) and relatively low equilibrium hydrogen pressures at elevated temperatures. The second new type of hydride was $ThTi_2H_{6\pm x}$ which crystallized with the hexagonal C14 structure. This hydride also had a high hydrogen density of 8.0 to 8.8 × 10^{22} hydrogen atoms per cm^3 and was relatively stable at elevated temperatures. High hydrogen density (high N_H) and low equilibirum hydrogen pressure are a generally sought after combination of characteristics for hydrides to be used in nuclear reactors and in other applications. Accordingly, these two new kinds of hydrides and their possible analogs may be of future use in a variety of applications. (auth)

Radiation Effects

Refer also to abstracts 24608, 25958, and 25987.

24662 (AECL–3679) PHASE TRANSFORMATION OF HYPERSTOICHIOMETRIC URANIUM CARBIDE. Oi, N. (Atomic Energy of Canada Ltd., Pinawa (Manitoba)). Dec 1970. 26p. Dep. NTIS (U. S. Sales Only). AECL $0.50.

Hyperstoichiometric UC fuels (4.85–5.31 wt % C) were found to have undergone a phase transformation during irradiation. Electron micrographs showed the formation of a spherical U_2C_3 phase at the UC_2 platelets. The formation of U_2C_3 was found to be extensive in fuel specimens irradiated at higher temperatures (~1200°C), and a partial phase transformation was also found in a fuel specimen irradiated at <800°C. No fission gas bubbles were observed in specimens where phase transformation had occurred. The phase transformation increases the fuel density. Annealing experiments on transformed carbide specimens were carried out at 1200 to 1450°C for 3 hours. It was found that the presence of U_2C_3 spheres markedly enhances dimensional stability; few or no fission gas bubbles were observed irrespective of carbon content of the specimens. The tentative suggestion here is that the solubility of fission gases in U_2C_3 is higher than in UC or UC_2 and that U_2C_3 absorbs any excess fission gas atoms present in the UC and UC_2 phases. The U_2C_3 phase was found to originate from the reaction $UC + UC_2 \rightarrow U_2C_3$ and annealing studies suggested that the U_2C_3 spheres formed by a continual precipitation and coalescence process. At the higher annealing temperatures some of the U_2C_3 phase is observed to segregate to the grain boundaries. (auth)

24663 (DP-Report-583) POST-IRRADIATION METALLOGRAPHIC EXAMINATION OF FUEL CARTRIDGES FROM TWO UPRATED FUEL ELEMENTS DISCHARGED FROM THE DRAGON REACTOR. Project DRAGON. Hankart, L. J. (Atomic Energy Establishment, Winfrith (England)). Jul 1967. 29p. Dep. NTIS (U. S. Sales Only).

Results obtained from the metallographic examination of fuel cartridges from two uprated fuel element employed in the 10 MW power run of the first charge of the Dragon Reactor are summarized. A series of fuel cartridges from the two elements were selected to cover the whole spectrum of temperature and burn-up variations along the fuel tubes and also to include the range of coated particle fuel batches employed. A total of 22 (Zr,U)C fueled cartridges were examined. The cartridges in the outer rods of the elements contained twice the normal fuel loading, while the cartridges in the center rods had an uprating factor of 2.6. (auth)

24664 (GEAP–10287) ZIRCALOY-CLAD UO_2 FUEL ROD EVALUATION PROGRAM. Quarterly Progress Report No. 12, August–October 1970. Megerth, F. H. (comp.) (General Electric Co., San Jose, Calif. Reactor Fuels and Reprocessing Dept.). Nov 1970. Contract AT(04-3)-189. 48p. Dep. NTIS.

Diameter profiles were obtained on four fuel rods as a means of further investigating certain areas that were believed to possibly be defective. The profiles of three rods revealed no evidence of defects. The fourth rod did show two peaks of uncertain causes up to 0.0064 cm on the diameter. Nothing specific was noted during the visual examinations or on the neutrographs of this rod that would give rise to these peaks. The lack of any difficulty in maintaining a vacuum on this rod during the collection of the contained free gases and the normal analysis obtained are evidence that the rod was sound. Length measurements made on 12 rods indicated increases over the pre-irradiation lengths of 0.15 to 0.33 cm. The average increase in length was 0.23 cm, or 0.23 percent. However, uncertainties in the pre-irradiation lengths reduced the accuracy of the data, and, at present, there is some question as to whether the plenum support tubes inside the rods may have been a factor in the length increases. The free gas contained in selected fuel rods was analyzed for fission gas release and composition. The percentages of fission-generated ^{85}Kr that were released from the UO_2 matrix to the internal void volume ranged from 0.1 to 0.7 percent. The compositions of the gas samples, determined by chromatographic analysis and mass spectrometry, appeared quite normal. The cladding and fuel of several transverse fuel rod sections were examined metallographically. The hydrogen content of the cladding was visually estimated to be no greater than 100 ppM; distribution of the hydride platelets was uniform. Oxide weight gains, determined from thickness measurements made on the external ZrO_2 layers, ranged from 170 to 1090 mg/dm^2 among the different metallography specimens and had a mean value of 490 mg/dm^2. The thickness of the ZrO_2 layer varied considerably around the circumference of some specimens. The specimens showed circumferential-average crud thicknesses between 4 and 18 microns for 1500 days of Dresden operation. The mean thickness for the group of specimens was 14 microns. The ZrO_2 films on the internal cladding surfaces were quite even and continuous in some cases and spotty in others. Where the films were continuous, the thicknesses averaged 4 to 9 microns among the different specimens and had a mean value of 8 microns. The UO_2 of three specimens was examined in the as-polished and etched conditions, and evidence of equiaxed central grain growth was observed in two of them. Precipitates were seen within the grains of the etched fuel. The highest concentrations were near the pellet peripheries and also in areas of various sizes that extended from the centers to points

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$\leq \frac{1}{2}$ of the pellet radius. Samples from the peak exposure locations of eight rods were analyzed for burnup by measuring the neodymium isotopes. The sample burnups ranged from 9×10^{20} to 1×10^{21} fissions/cm^3. The ratios of peak burnup to average burnup, obtained from the gamma scans, were applied to determine the rod-average burnups. These values ranged from 8×10^{20} to 9×10^{20} fissions/cm^3. (auth)

24665 FORMATION OF HELIUM GAS BUBBLES IN NEUTRON-IRRADIATED COPPER-BORON ALLOYS. Barry, D. E. (Atomic Energy Research Establishment, Harwell, Eng.). Phil. Mag.: 23: 495-507(Feb 1971).

The influence of the concentration of helium on the formation of bubbles was examined in an alloy which contains regions with different helium concentrations. It is found that the helium aggregates into bubbles greater than about 50 Å in diameter only if its local atomic concentration exceeds a critical value between 4×10^{-5} and 3×10^{-4}. (auth) (UK)

24666 IRRADIATION EFFECTS ON LOW TEMPERATURE THERMAL AND ELECTRICAL CONDUCTIVITIES OF TWO GRAPHITES. Powell, R. L. (National Bureau of Standards, Boulder, Colo.); Wagner, Paul. Carbon: 8: 690-2(Nov 1970).

Graphs are presented showing the effect of irradiation at 6-100°K on Graphitite-G and H4LM grade graphites, at an integrated neutron dose of 1.73×10^{18} nvt and total gamma 3×10^9 rad. Irradiation reduced the thermal conductivity by a factor of 8 at 100°K, and caused an increase in electrical resistivity. Change in the value of the Lorentz function compared with the change in total thermal conductivity suggested that the lattice component was more severely effected than the electronic component. Recovery curves obtained from annealing experiments are shown. (UK)

24667 C-AXIS MICROCONE FORMATION IN NUCLEAR GRAPHITES DUE TO GRAPHITE REMOVAL BY IMPURITY-INHIBITED ELECTRONICALLY-EXCITED OXIDATION REACTIONS. Jones, S. S. (Battelle-Northwest, Richland, Wash.). Contract AT(45-1)-1830. Carbon: 8: 681-3(Nov 1970).

The formation of a cone-shaped microstructure by graphite removal was observed in certain nuclear graphites. These cone structures are produced in TSX and AGOT-LS graphite by electronically-excited reactions involving oxygen, carbon dioxide, and/or water vapor. The microcones are formed with a wide range of span angles and with the principal cone axis perpendicular to the graphite basal planes. Microcone formation is more efficient at low gas pressure than at high pressure, and appears to result from oxidation by negatively-charged, transient species with a lifetime of less than 10 msec. The mechanism of cone formation involves oxidation inhibition by small elements of impurity which are always found at the cone tips. Information is presented concerning the structure of these microcones and various stages of cone development. (auth) (UK)

24668 CREEP OF CERAMIC FUEL ELEMENTS UNDER NEUTRON IRRADIATION. Brucklacher, D.; Dienst, W.; Thuemmler, F. (Kernforschungszentrum, Karlsruhe, Ger.). Atomwirt., Atomtech.; 16: 32-3(Jan 1971). (In German).

The thermal rod effect on creep rate, which was only slightly temperature dependent, was studied at low fuel temperatures in the range between 400 and 700°C. For this purpose, a fuel-creep capsule was developed. To obtain a temperature gradient as low as possible and to maintain a good connection of the fissionable material in the case of ruptures, the samples were compiled by alternating 1mm thick UO_2 and molybdenum rings. Thus far, creep studies were performed on UO_2 with approximately 96% of the theoretical density, grain size of 30 to 40 μm, fission rate of 5×10^{-9}/sec., and irradiation exposure from 1,000 to 1,500 hours. Results showed that the creep rate of UO_2 fell in the range of thermal rods and was higher than the linear swelling rate. The creep rate of UN and UC appeared to be ten times lower than that of UO_2 and, therefore, fell into the interval range between thermal rods and thermal spikes. (H.B.G.)

Plastics and Other Materials

Refer also to abstracts 23599, 24565, 24581, 24611, 25975, 25976, and 26006.

24669 (AECL-3674) THE CHEMICAL VAPOUR DEPOSITION AND BURST TESTING OF SILICON CARBIDE TUBES. Phillips, E.; Lukas, K. (Atomic Energy of Canada Ltd., Pinawa (Manitoba)). Feb 1971. 22p. Dep. NTIS (U. S. Sales Only). AECL $1.00.

The chemical vapor deposition of small silicon carbide tubes is described. A hydrogen/methyltrichlorosilane molar ratio of 2.5: 4.9 with a total flow rate between 1200 and 2240 cm^3/min gave dendritic microstructures free from striations. Hoop tensile strengths of up to 52,587 lbf/in^2 and 42,400 lbf/in^2 were obtained with 0.25 in. ID and 0.5 in. ID tubes respectively. (auth)

24670 (BNL-15139) REPORT ON POLYMER CONCRETE APPLICATIONS DEVELOPMENT FOR THE BUREAU OF PUBLIC ROADS. DESIGN STUDIES ON HIGHWAY BRIDGE DECKING AND LUMINAIRE SUPPORTS: JANUARY 1969-JUNE 1970. Reich, M.; Hendrie, J. M. (Brookhaven National Lab., Upton, N. Y.). Aug 1970. 113p. Dep. NTIS.

Results of research on properties of concrete-polymer materials are reported. Design studies related to overall applications and to applications in roads were carried out during the period. It was found that concrete luminaire structures can be advantageously used along highways. Such structures will safely withstand wind forces of 120 mph and should, in the event of a collision, cause a change in automobile velocity well within the prescribed safety limits. Experimental determinations of the cyclic loading values based on the risk of rupture concept, together with evaluations of the energy absorption indices for concrete-polymer materials are necessary prerequisites before detailed design work is undertaken. Results of highway bridge decking studies are also reported in which the technique used was to study crack formation phenomena in concrete and to develop better analytical methods than have been used in the past. (J.R.D.)

24671 (TRG-Report-2070) VELOCITY OF SOUND IN CARBON DIOXIDE AT LOW TEMPERATURES. Rapier, A. C. (United Kingdom Atomic Energy Authority, Sellafield (England). Reactor Group). 1970. 15p. Dep. NTIS (U. S. Sales Only). UK 2s.

The investigation of the generation of noise and its effects on components in reactor circuits requires a knowledge of the velocity of sound in carbon dioxide at relatively low temperatures where there are significant deviations from the ideal gas law and for which no tabulated data are available. An equation of state for temperatures in the range 0 to 100°C is found which fits the experimental data, and from this the velocity of sound is deduced. (auth) (UK)

24672 EFFECT OF HIGH-ENERGY IRRADIATION ON WOOD. Lawniczak, M.; Raczkowski, J. (Inst. of Mechanical Tech. of Wood WSR, Poznan, Poland). Drevo; 24: 260-4(Sep 1969). (In Slovak).

The effects of gamma irradiation on physical and mechanical properties of wood and on wood resistance to fungi and insect damage are reviewed. Radiation affects the mechanical properties of wood; at doses exceeding 10^7 Rad, these are reduced by as much as 90%, doses below 10^7 Rad in many cases improve them (by less than 10%). During irradiation, two processes take place in wood: cross-linking and decomposition. The applied dose rate as well as the total dose determine which of the two prevails. For this reason, the same dose affects the individual mechanical properties in a different way. An irradiation dose below 10^6 Rad does not reduce the resistance to fungi and insect damage. (NSA of Czech.)

24673 INFLUENCE OF HIGH ENERGY RADIATION ON HIGH-POLYMERS DURING MECHANICAL LOAD. Steiner, N.; Kowalewsky, H. (Bundesanstalt fuer Materialpruefung, Berlin). Kaut. Gummi Kunstst.: 23: 317-22(1970). (In German).

The effect of ^{60}Co gamma radiation on technological properties and the radiation-chemical yield on networks and degradation processes of poly(methyl methacrylate) (PMMA) and cis-1,4-polyisoprene were studied as far as type and degree of the mechanical load was concerned. By dynamic loading of PMMA during irradiation the G-values of degradation are increased by 20% at the frequency and temperature of the secondary relaxation maximum. The radiation-chemical degradation occurs primarily via the cracking of side-chains. Using a multiple-network theory it was found that the G-values of degradation and of the secondary network-chain formation of a two-network cis-1,4-polyisoprene are not influenced by irradiation in vacuum at an elongation up to 135% of the original length. Uniaxially elongated or compressed cis-1,4-polyisoprene samples quickly lose their tension during irradiation and become useless. Secondary networks arise via temporary cracks and are tri-functional. (INIS)

PHYSICS (GENERAL)

Astrophysics and Cosmology

24674 (JINR–E2-5587) HEAVY LEPTON AND NEUTRINO ASTRONOMY. Pontecorvo, B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1971. 7p. Dep. NTIS (U. S. Sales Only).

It is shown that hypothetical existence of heavy leptons can be of importance in neutrino astrophysics. (auth)

24675 ASPECTS OF NEUTRINO ASTROPHYSICS. de Graaf, Tjeerd. Groningen, Netherlands; Rijksuniversiteit (1969). 124p. Thesis.

A review is given of theories that describe weak-interaction processes where neutrinos are involved. The possible implications for astrophysics of the phenomena predicted by these theories are indicated. A number of processes are considered in which neutrinos are involved and the cross sections of these processes are calculated by assuming the theory with a universal Fermi Interaction. A review is presented of the possibilities for the neutrino background and its energy density as a component of the total density of matter–energy in the universe. Possible physical interactions in which these neutrinos are involved are considered. (W.D.M.)

Cosmic Ray Exposure Ages

24676 LASER MICROSPECTRAL INVESTIGATION OF METEORITES. Nikolov, N.; Petkov, A. P.; Dimitrov, G.; Dimov, D. (Univ., Sofia). Mem. Soc. Roy. Sci. Liege; 19: 267-73(1970).

From 16th International Conference on Astrophysics, Liege, Belgium. See CONF-690653.

The preliminary results of the microspectral investigation of two Bulgarian meteorites with the help of laser technique are reported. The main result of the use of this method for investigation of meteorites is the possibility to analyze microregions and even nonhomogeneities in a microregion (a chondrule for instance) which may be of importance in resolving some astrophysical evolutionary problems as well as problems of the theory of nucleosynthesis. (auth)

24677 HELIUM, NEON, AND ARGON IN SEPARATED PHASES OF IRON METEORITES. Schultz, L.; Funk, H.; Nyquist, L.; Signer, P. (Swiss Federal Inst. of Tech., Zurich). Geochim. Cosmochim. Acta; 35: 77-88(Jan 1971).

The isotopic composition and concentration of He, Ne, and Ar produced by cosmic rays were measured spectrometrically in bulk samples and in taenite and schreibersite phases of four iron meteorites. The ^{3}He concentrations in taenite are lower than those in either schreibersite or bulk samples. This difference cannot be attributed solely to variations in chemical composition and is contradictory to observations of hydrogen diffusion in kamacite and taenite. The ^{4}He, neon, and argon concentrations in taenite fit the spallation systematics for iron meteorites well. Furthermore, calculations of the concentrations (based on the Rudstam spallation model) agree well with the observed data. Thus, it is concluded that no fragmentation processes with anomalous cross sections occur in the production of neon from phosphorus. (auth) (UK)

24678 NEUTRON-ACTIVATION POTASSIUM–ARGON DATING OF METEORITES. Podosek, Frank A. (Univ. of California, Berkeley). Geochim. Cosmochim. Acta; 35: 157-73(Feb 1971).

Argon analyses are presented for stepwise heating of nine specimens of seven neutron-irradiated meteorites, and potassium–argon ages calculated by the $^{40}Ar-^{39}Ar$ method. Within the limitations of the data, it is found that the chondrites Karoonda, St. Severin, and Allegan, and the aubrites Peña Blanca Spring and Bishopville, all have identical potassium–argon gas-retention ages, assumed to be 4.6×10^{9} yr. In particular, Bishopville, for which conflicting age results have been reported, has the same K–Ar age as the chondrites and Peña Blanca Spring. For these five meteorites, there is no evidence for significant loss of radiogenic ^{40}Ar, such as has been observed in hypersthene chondrites. Gas released at low extraction temperatures indicates that a silicate inclusion from the hexahedrite El Taco experienced a heating event 3.4×10^{9} yr ago. Gas released from El Taco silicate at higher extraction temperatures yields a K–Ar age identical to that of the chondrites, large amounts of trapped ^{36}Ar, and indicates a ratio ($^{40}Ar/^{36}Ar$) $\gtrsim 2$ in the trapped argon. The results for separated chondrules and matrix of the unequilibrated chondrite Chainpur differ qualitively from those observed for other meteorites in a manner for which no tenable explanation is offered. (auth) (UK)

24679 TRAPPED NEON–ARGON ISOTOPIC CORRELATIONS IN GAS RICH METEORITES AND CARBONACEOUS CHONDRITES. Black, David C. (Univ. of Minnesota, Minneapolis). Geochim. Cosmochim. Acta; 35: 230-5(Feb 1971).

Trapped argon in gas-rich meteorites and carbonaceous chondrites is found to vary in isotopic composition. The variations correlate with associated variations in the trapped $^{20}Ne/^{22}Ne$ ratio. The correlation found here, as well as those observed earlier for trapped helium and neon, indicates a complex but strongly coupled history for trapped light rare gases in meteorites. (auth) (UK)

24680 RADIATION AGE OF THE NORTON COUNTY METEORITE. Herzog, G. F.; Anders, E. (Univ. of Chicago). Geochim. Cosmochim. Acta; 35: 239-44(Feb 1971).

The radiation age of the Norton County aubrite was redetermined as 107 m.y. by the $^{21}Ne/^{26}Al$ method—much shorter than the earlier values of 220 and 500 m.y. obtained by the $^{3}He/^{3}H$ and $^{38}Ar/^{39}Ar$ methods. The new value no longer contradicts the notion that radiation ages of stony meteorites are governed by their lifetimes against collisional fragmentation. (auth) (UK)

24681 ASYMMETRIC DISTRIBUTION OF THERMOLUMINESCENCE IN THE UCERA METEORITE. Voz, J. E. Nature (London) Phys. Sci.; 230: 23-4(1 Mar 1971).

The variations of the thermoluminescence output with depth below the fusion crust of the recently fallen Ucera meteorite are reported. Details of the sample used are given. Typical glow curves are shown in which there are two peaks evident at about 240 and 375°C. A variation is seen in the thermoluminescence output of the samples with distance from the surface of the stone that can be explained by the effect of atmospheric heating on the thermoluminescence induced in the specimen by cosmic-ray irradiation. Variations due to the nonuniform shielding of the meteorite from cosmic rays are also observed. (UK)

24682 APPLICATIONS OF THE INERT GASES. Smith, B. L. (Univ. of Sussex, Eng.). Contemp. Phys.; 12: 105-32(Mar 1971).

The inert gases have recently been recognized by physicists as useful substances with which to investigate the relationship between microscopic and marcoscopic theories of matter, because their properties may be represented by simple theoretical models. However, there are many other areas in physics, particularly near the boundaries, where they now play an equally valuable role. In astrophysics, for example, analysis of the inert gas content of minerals and meteorites helps to date the origin of the Universe. Electron microscope and diffusion studies of the inert gases in metals may solve a vitally important problem encountered in nuclear reactors. The discovery of stable inert gas compounds is a challenge to molecular bonding theory. Inert gas lasers provide physicists with a powerful probe with which to investigate the properties of liquids. These, together with many other applications, establish the inert gases as invaluable tools for research. (auth) (UK)

Stars

24683 (MPI-PAE/EXTRATERR–38) DEVELOPMENT OF A STAR ATMOSPHERE SIMULATOR. Specht, J. v. (Max-Planck Institut fuer Physik und Astrophysik, Munich (West Germany)). Apr 1970. 8p. (In German). Dep. NTIS (U. S. Sales Only).

A star atmosphere simulator, based on the principle of heating a hydrogen plasma by a system of arcs at its boundary, was developed. The principle of the simulator is discussed in some detail. The electrodes and the arc system are described. The series resistance of the electrodes was determined. Side-on and end-on observations of the plasma are described. Experiments planned with the simulator are indicated. (J.S.R.)

24684 SIX-COLOUR PHOTOMETRY OF GALACTIC CLUSTERS. Goodenough, David George. Toronto; Univ. of Toronto (1969). National Library of Canada, Ottawa.

Thesis.

Six-color observations on the DDO system are reported for

155 cluster stars. Telescopes of the David Dunlap Observatory, the Cerro Tololo Inter-American Observatory, and the Kitt Peak National Observatory were used for these observations. The following clusters were observed: NGC 188, NGC 752, the Pleiades, the Hyades, NGC 2362, NGC 2451, NGC 2477, M67, NGC 6633, and the globular cluster 47 Tucanae. The unreddened six-color sequences are presented in the form of color–spectral type diagrams. Using color–color diagrams a method (McClure 1969) is developed for correcting the observed cyanogen strength for the effects of surface gravity in stars later than G8. A corrected cyanogen index is formed which correlates linearly with the logarithm of the stellar iron-to-hydrogen ratio, Fe/H. The following clusters are found to have the same Fe/H ratios, within a factor of 1.1: NGC 188, the Hyades, NGO 2451, NGC 2477, M67, and NGC 6633. This result indicates that there has been little, if any, overall metal enrichment in the Galaxy during the last six billion years. The sparse cluster NGC 752 is found to be metal poorer than the Hyades by a factor of 1.7. This implies that substantial compositional differences occur in different regions of the Galaxy. As a group the strong-cyanogen stars are found to be slightly more metal-rich than the Hyades. (Diss. Abstr. Int., B)

24685 PROMETHIUM IN THE STAR HR 465. Aller, Margo F. (Univ. of Michigan, Ann Arbor). Sky Telesc.; 41: 220-2(Apr 1971).

Recently the existence of the short-lived unstable element promethium in the atmosphere of the peculiar A star HR 465 was discovered. Its detection reopens the questions of the origin of Ap stars and of the possibility of nucleosynthesis in their atmospheres. The background of this discovery is outlined and the procedures that were followed in the analysis are described. (W.D.M.)

24686 HD 161227: A SCANDIUM-DEFICIENT F-TYPE STAR. Preston, George W. (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Publ. Astron. Soc. Pac.; 83: 48(Feb 1971).

All lines of Sc II are very weak in the spectrum of the F0 II star HD 161227. If the luminosity assignment is correct, this star may be a post-main-sequence example of a hot Am star in which metallic-line characteristics are still detectable. (auth)

24687 WERE THE ELEMENTS SYNTHESIZED IN STELLAR EXPLOSIONS? Clayton, Donald D. (Rice Univ., Houston, Tex.). Comments Astrophys. Space Phys.; 3: 13-19(Jan-Feb 1971).

The situation with regards to the synthesis of nuclei between carbon and iron is summarized. The explosive burning of ^{12}C, ^{16}O, and ^{28}Si is considered and the astrophysical consequences of the experimental verification of this burning are presented. (W.D.M.)

24688 SUPERNOVAE AND THE EXTINCTION OF THE DINOSAURS. Russell, Dale (National Museum of Natural Sciences, Ottawa); Tucker, Wallace. Nature (London); 229: 553-4 (19 Feb 1971).

It is suggested that nearby supernova explosions might produce climatic effects so drastic as to cause the extinction of many animals, including the dinosaurs. The expected fluxes of cosmic and x rays and the resultant changes in the atmospheric circulation from such a supernova explosion are discussed. (UK)

24689 MAY OBSERVABLE AMOUNTS OF PLUTONIUM BE PRESENT IN THE SURFACES OF PECULIAR A STARS. Kuchowicz, B. (Univ., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci., Math., Astron. Phys.; 18: 673-5(Dec 1970).

If the recent determination of uranium in the spectrum of 73 Dra is assumed to be valid, then the r process has indeed occurred. If the r process has occurred, then it is conjectured that plutonium should be detectable in the spectra of peculiar A stars. (W.D.M.)

24690 THEORY OF THE LIGHT CURVES OF SUPERNOVAE. Grassberg, E. K. (Radioastronomical Observatory, Riga); Imshennik, V. S.; Nadyozhin, D. K. Astrophys. Space Sci.; 10: 28-51(Jan 1971).

An account of the theory of the light curves of supernovae, based on certain assumptions concerning the passage through the stellar atmosphere of powerful shock waves, is presented. The investigation is based on numerical integration of appropriate equations of gas dynamics and radiative heat conductivity. The calculations substantially involve the ionization and recombination of hydrogen in the envelope of a supernova. Changes are traced in the curves arising from the transition from compact stars with small radius (~10 $R_\odot$), to stars with very extensive envelopes (~10,000 $R_\odot$). The light curves for compact stars agree well with observations of the peculiar supernovae in NGC 5457, NGC 6946, and NGC 5236. The characteristics of the light curves with the passage of shock waves through the extended atmosphere coincide within an order of magnitude with observations of the supernovae of type II and type I near their maximum brightness. A powerful heat wave propagates before the shock front in the extensive atmosphere which gives rise to a detached supernova envelope in the form of a thin spherical layer. The condition in an ascending wave of cooling and recombination in the supernova envelope was investigated. It is shown that part of the hydrogen may recombine to attain full transparency for radiation passing through it. The observations are compared with the results of the theory of radioactive decay of the elements. This explanation of the light curves by the passage of shock waves requires energies of 10^{50} to 10^{52} ergs, which are in agreement with mechanisms of thermonuclear explosions. (auth)

24691 PRE-MAIN-SEQUENCE STELLAR EVOLUTION WITH MASS LOSS. Ezer, Dilhan (Goddard Space Flight Center, New York); Cameron, A. G. W. Astrophys. Space Sci.; 10: 52-70(Jan 1971).

A semi-empirical formulation is given of the rate of stellar mass loss by stellar winds. Evolutionary studies of stars in the pre-main sequence (T Tauri) stage are presented for a variety of rates of mass loss. It has been found that different mass loss rates produce only small changes in the positions of equal evolutionary time lines in HR diagrams. Thus it is concluded that the spread of points in HR diagrams of young clusters results from a spread in their times of formation. This is consistent with the initiation of star formation by violent hydrodynamic compression of a typical interstellar cloud. (auth)

24692 DETERMINATION OF THE CONTINUUM IN SOME EMISSION LINE OBJECTS. Caputo, Filippina (Laboratorio di Astrofisica, Frascati, Italy). Astrophys. Space Sci.; 10: 93-101(Jan 1971).

Excitation temperatures of the peculiar objects Boss 1985, AG Pegasi, and AG Carinae were derived from the corrected intensities of the emission lines. The values obtained were 5900K for Boss 1985, 8000K for AG Pegasi, and 10500K for AG Carinae. From the observed quantities log (I/I_c), where I is the intensity of the line and I_c the intensity of the underlying continuum, the true continuum was derived. The results are in good agreement with those predicted in previous investigations. (auth)

24693 ACCRETION OF INTERSTELLAR MATTER BY WHITE DWARFS. Castellani, Vittorio (Univ., Rome); Panagia, Nino. Astrophys. Space Sci.; 10: 122-35(Jan 1971).

The problem of the energy released by interstellar matter in its accretion by low-luminosity stars is examined. It is found that nearly all the gravitational energy is available as the energy source for the accreting star. When this source of energy becomes predominant, a luminosity–temperature relation can be derived. Evolutionary consequences for the white dwarfs are discussed. The behavior of selected classes of white dwarfs is recognized in the theoretical H–R diagram. The evidence for a separation between field white dwarfs and Hyades cluster white dwarfs is discussed. For the Hyades white dwarfs, a well-defined sequence in good agreement with a "constant accretion locus" is found. A critical discussion is given on the efficiency of the accretion mechanism in the Hyades dwarfs. (auth)

24694 PHYSICAL CONDITIONS IN THE CONVECTIVE ENVELOPE OF STARS. II. CONVECTION IN CRITICAL CONDITIONS. Castellani, V. (Univ., Rome. Laboratorio di Astrofisica, Frascati, Italy); Puppi, L.; Renzini, A. Astrophys. Space Sci.; 10: 136-49(Jan 1971).

The mechanical flux originating in the convective envelope of stars is shown to depend critically on the treatment of convection. In particular, in the framework of the mixing-length theory, in passing from a mixing length $l = H_p$ to a mixing length $l = H_p$ the presence of mechanical fluxes shifts from being a marginal phenomenon to a dominant one. Possible implications concerning atmospheric microturbulence in main-sequence stars, such as A_p and A_m stars, several types of variables and mass loss are briefly discussed. (auth)

24695 YTTRIUM AND MERCURY IN Mn-TYPE PECULIAR A STARS. Guthrie, B. N. G. (Royal Observatory, Edinburgh). Astrophys. Space Sci.; 10: 156-64(Jan 1971).

The relative abundances of Sr, Y, and Zr in six Mn-type peculiar A stars were derived from a curve-of-growth analysis. Isotope shifts of the Hg II 3984 line showed that the mean atomic weight of the mercury in Mn-type stars is less than in other peculiar A stars. The nucleosynthesis of Y and Hg is discussed for the Mn-type stars on the theory that peculiar A stars were once secondar-

ies in binary systems in which the primaries exploded as type II supernovae. During the explosions (γ,n) reactions probably formed Hg from Pb and modified the structure of the Sr–Y–Zr s-process peak. Later, protons accelerated in shock waves around the secondaries formed Y from Sr. (auth)

24696 STATIC THEORY OF THE STABILITY OF THE EQUILIBRIUM. Calamai, Giulio (Osservatorio Astrofisico di Arcetri, Florence). Astrophys. Space Sci.; 10: 165-77(Jan 1971).

A static relativistic theory of the stability of the equilibrium of an isentropic spherically symmetric star is deduced from the properties of a function u which is a solution of a second-order differential equation, and which is related to the model by means of the formula $u = \partial m(v,\rho_c)/\partial\rho_c$, where m is the mass–energy inside the coordinate volume v and ρ_c is the central mass–energy density. (auth)

24697 SPECTROSCOPIC AND PHOTOMETRIC INVESTIGATION OF NGC 7243. Hill, Graham (Dominion Astrophysical Observatory, Victoria, B. C.); Barnes, Jeannette V. Astron. J.: 76: 110-16(Mar 1971).

Results of a spectroscopic and photometric investigation of NGC 7243 are presented. A distance modulus of 9.4 ± 0.1 m was found and a cluster age of 76×10^6 yr was determined from the brightest star. Included in the cluster is one peculiar A star (A0 Vp) and one Am star. The Am star is tentatively identified as a spectroscopic binary. Of the 28 cluster members for which radial velocities were measured, eight stars are possible spectroscopic binaries. The mean cluster velocity is −9.3 ± 1.0 km/sec. (auth)

24698 CALIBRATION OF THE ZERO-AGE MAIN SEQUENCE VIA G8-K3 STARS OF LARGE PARALLAX. Upton, Edward K. L. (Univ. of California, Los Angeles). Astron. J.: 76: 117-22(Mar 1971).

The zero point of the M_V versus (B − V) relation in Praesepe is determined by fitting the Praesepe curve to 28 G8 to K3 stars within 13 pc of the Sun. On the assumption that stars depart from the Praesepe main sequence by an amount ΔM_V which is proportional to their ultraviolet excess, it is found that $\Delta M_V = 6.7\delta$ (U − B) with a large uncertainty in the coefficient, and that $M_V = 5.75 \pm 0.04$ (p.e.) at B − V = 0.80 on the Praesepe sequence. This calibration differs by only 0.03 mag from the result obtained by the author from proper motions in the Hyades. The combined results of the two methods yield $M_V = 5.76 \pm 0.03$ at B − V = 0.80 on the Hyades–Praesepe main sequence. The average main sequence for the disk population is about 0.14 mag fainter at a fixed value of B − V. (auth)

24699 DISTANCES OF PLANETARY NEBULAE. Smith, Haywood Jr. (Leander McCormick Observatory, Charlottesville, Va.). Astron. J.: 76: 193-7(Mar 1971).

Comparison of several distance scales for planetary nebulae with two sets of "standard" distance estimates confirms the theoretical prediction that the Shklovsky method overestimates the distances to nebulae that are optically thick (i.e., not completely ionized). The prediction that the Zanstra method overestimates the distances of optically thin nebulae is not confirmed for all cases. The "standard" distance scales suggest the existence of an evolutionary relation between radius and expansion velocity for planetary nebulae. At least one theoretical model is in good agreement with this relation. New distance estimates from this relation are given for 26 planetaries. (auth)

24700 DYNAMICS OF THE GRAVITATIONAL TWO-STREAM INSTABILITY. Hohl, Frank (Langley Research Center, Hampton, Va.). Astron. J.: 76: 202-5(Mar 1971).

A computer model, which simulates the motion of stars in the plane of disk-like stellar systems, was used to investigate the dynamics of the Jeans instability and of the gravitational two-stream instability. The numerical results show that for no streaming the condensations which form are about two Jeans lengths in diameter. Also, the amount of energy in rotation for a condensation is found to vary from 0.1% to 16% of its total kinetic energy. Star streaming has little effect for streaming velocities less than the velocity dispersion of the two star streams. For larger streaming velocities, the structure that results is reminiscent of the spiral structure of certain galaxies. (auth)

24701 PRE-MAIN-SEQUENCE STELLAR EVOLUTION. Communications Presented at the 16th International Astrophysics Conference, Liege, Belgium, June 30–July 2, 1969. Mem. Soc. Roy. Sci. Liege; 19: 1-377(1970). (In French and English). (CONF-690653).

Separate abstracts were prepared for 31 of the 38 papers presented. (W.D.M.)

For abstracts of individual papers see: 24676, 24702–24727, 24758, and 24796–24798.

24702 THEORY OF STAR FORMATION. INTRODUCTORY REPORT. Field, George B. (Univ. of California, Berkeley, Cambridge Univ., Eng.). Mem. Soc. Roy. Sci. Liege; 19: 29-45(1970).

From 16th International Conference on Astrophysics, Liege, Belgium. See CONF-690653.

A model for star formation is presented that is consistent with many observations. The difficulties in sorting out the dynamical behavior of a system are considered in which gravitational, thermal, turbulent, magnetic, and cosmic-ray energy densities are comparable. The model is a modification of one proposed by Oort (1954) and addresses itself to the problem of why all gas does not collapse to form stars on the gravitational time scale $(3\pi/32G\rho)^{1/2}$ = 50 mg for ρ = 1H cm^{-3}. (W.D.M.)

24703 STAR FORMATION IN CLUSTERS AND THE STELLAR MASS FUNCTION. Hartmann, William K. (Univ. of Arizona, Tucson). Mem. Soc. Roy. Sci. Liege; 19: 49-64(1970).

From 16th International Conference on Astrophysics, Liege, Belgium. See CONF-690653.

An independent discussion of the mass function, using recent studies of the solar neighborhood and three open clusters, suggests that most local stars formed in open clusters. The mass function in the solar neighborhood is given. There is some evidence that an admixture of younger-than-normal stars exists within 5 parsecs, possibly contributed by the Ursa Major cluster. It is pointed out that the meaning of the initial mass function (IMF) depends on the origin of binary and multiple systems. The mass function of three open clusters and an approximate duration of 2×10^8 years for star forming activity in open clusters are derived. Two IMF models, I and II, based on stellar evolution calculations are presented; model II is favored. The abundance and formation of low-mass stars are discussed. The IMF peaks at about 0.1 to 1.0 $M_\odot$ and cannot be simply extrapolated to low masses. Formation of low-mass stars is impeded, and such stars may have abnormal hydrogen abundances. (auth)

24704 STAR FORMATION IN CLOUDS OF SOLID HYDROGEN GRAINS. Reddish, V. C. (Royal Observatory, Edinburgh). Mem. Soc. Roy. Sci. Liege; 19: 67-73(1970).

From 16th International Conference on Astrophysics, Liege, Belgium. See CONF-690653.

The suggestion that hydrogen is frozen onto grains in the more dense, cold interstellar clouds and that stars form from such clouds of solid hydrogen grains (Wickramasinghe and Reddish, 1968) has met with objection mainly on four grounds: the interstellar densities are too low; the saturated vapor density of solid hydrogen is too high; the hydrogen will photo-dissociate; and interstellar grain temperatures are too high. These objections are briefly discussed. (W.D.M.)

24705 RESULTS OF A COMPUTER PROGRAM FOR GRAVITO–GAS DYNAMICAL COLLAPSE. Wright, Alan E. (York Univ., Toronto). Mem. Soc. Roy. Sci. Liege; 19: 75-87(1970).

From 16th International Conference on Astrophysics, Liege, Belgium. See CONF-690653.

Some results, of interest to theories of star formation, from a computer program for following the evolution of a gas cloud collapsing under self-gravitation are described. (auth)

24706 FRAGMENTATION OF INTERSTELLAR GAS CLOUDS. McNally, D. (London Univ.). Mem. Soc. Roy. Sci. Liege; 19: 89-93(1970).

From 16th International Conference on Astrophysics, Liege, Belgium. See CONF-690653.

The roles of nonuniform density distributions and the interaction of atomic physics with the dynamics of the collapse in promoting the fragmentation of interstellar gas clouds are shown to be of primary importance. It is shown that, if almost free-fall conditions can be established in a gas cloud, fragmentation becomes inevitable. (auth)

24707 THEORY OF STAR FORMATION. Wright, Alan E. (York Univ., Toronto). Mem. Soc. Roy. Sci. Liege; 19: 95-8 (1970).

From 16th International Conference on Astrophysics, Liege, Belgium. See CONF-690653.

A possible evolutionary path is traced for a protostar from a diffuse cloud of interstellar gas of density 10^{-23} g cm^{-3}, through fragmentation, to the time at which nuclear burning will commence

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and a mean density of ~1 g cm^{-3} is achieved. The conclusion is reached that only masses of gas with a mass $>10^{32}$ g can contract to become pre-main-sequence stars. (auth)

24708 COUPLING BETWEEN STAR FORMATION AND THE FORMATION OF H II REGIONS. Hjellming, Robert M. (National Radio Astronomy Observatory, Green Bank, W. Va.). Mem. Soc. Roy. Sci. Liege; 19: 105-11(1970).

From 16th International Conference on Astrophysics, Liege, Belgium. See CONF-690653.

The presence of dense clouds in H II regions is interpreted in terms of the effects of an H II region forming around protostar clouds that are initially in a state of quasi-equilibrium. The process initiates star formation in molecular hydrogen clouds with masses in excess of a particular critical mass, with clouds of lesser mass adjusting to more compact equilibrium configurations. Sizes and densities of these clouds are calculated and estimates are made of time scales and rates of mass loss to the H II region. (auth)

24709 GRAIN TEMPERATURES IN INTERSTELLAR DUST CLOUDS. Werner, Michael W., Salpeter, E. E. (Inst. of Theoretical Astronomy, Cambridge, Eng.). Mem. Soc. Roy. Sci. Liege; 19: 113-20(1970).

From 16th International Conference on Astrophysics, Liege, Belgium. See CONF-690653.

Grain temperatures as a function of position and other quantities of interest in studies of star formation were calculated for spherical dust clouds. A range of grain models was considered. Formation of H_2 by recombination on the surface of grains is discussed. A large abundance of gaseous H_2 may be present in dense clouds, but it is shown that grains of the types considered do not become sufficiently cold in the dust clouds commonly observed in the Galaxy to permit the formation of solid H_2 mantles. (auth)

24710 COLLAPSE AND CONTRACTION TO THE MAIN SEQUENCE. INTRODUCTORY REPORT. Hayashi, Chushiro (Kyoto Univ.). Mem. Soc. Roy. Sci. Liege; 19: 127-40(1970).

From 16th International Conference on Astrophysics, Liege, Belgium. See CONF-690653.

Topics discussed include formulation of the collapse process, collapse and flare-up, and slow contraction to the main sequence. (W.D.M.)

24711 NONLINEAR PULSATIONS OF PROTOSTARS. Graham, Eric (Univ. of Manchester, Eng.). Mem. Soc. Roy. Sci. Liege; 19: 141-4(1970).

From 16th International Conference on Astrophysics, Liege, Belgium. See CONF-690653.

Six equations are given for the motion of a spherically symmetric gas mass. A model based on these equations, which lies high in the H-R diagram and does not have a position near any observed nebular variable, is investigated. (W.D.M.)

24712 EVOLUTION OF A PROTOSTAR. Williams, I. P.; Cremin, A. W. (Univ. of Reading, Eng.). Mem. Soc. Roy. Sci. Liege; 19: 147-51(1970).

From 16th International Conference on Astrophysics, Liege, Belgium. See CONF-690653.

If a protostar of an intermediate mass behaves as a star of that mass would on the Hayashi evolutionary track, it is possible to construct an evolutionary track for a star forming according to the McCrea theory. If this track behaves in a reasonable fashion it may or may not indicate the correctness of the McCrea theory, but if it behaves in an unacceptable fashion it is strong evidence against the theory. Such a track is constructed. (W.D.M.)

24713 EFFECTS OF ROTATION, MAGNETIC FIELDS, PLANETARY SYSTEMS, ANGULAR MOMENTUM IN STARS, SPIN-DOWN, BINARY, AND MULTIPLE STARS. INTRODUCTORY REPORT. Mestel, L. (Univ. of Manchester, Eng.). Mem. Soc. Roy. Sci. Liege; 19: 167-94(1970).

From 16th International Conference on Astrophysics, Liege, Belgium. See CONF-690653.

This discussion is slanted more towards the phases following the formation of a star, rather than toward the cosmogonical problems of star formation. Topics discussed include: star formation; pre-Hayashi phase; Hayashi phase; effect of Hayashi convection on rotation and magnetic fields; magnetic braking by stellar winds; binary systems; and spin-down. (W.D.M.)

24714 ROTATION OF INTERSTELLAR GAS CLOUDS. McNally, D. (London Univ.). Mem. Soc. Roy. Sci. Liege; 19: 195-7(1970).

From 16th International Conference on Astrophysics, Liege, Belgium. See CONF-690653.

It is argued that rotational effects cannot be significant contributors to the dynamics of the early stages of gravitational collapse on the grounds that the lifetimes of interstellar gas clouds are too short for the acquisition of significant amounts of angular momentum. (auth)

24715 EVOLUTION OF RAPIDLY ROTATING PRE-MAIN-SEQUENCE STARS. Bodenheimer, Peter. (Univ. of California, Santa Cruz). Mem. Soc. Roy. Sci. Liege; 19: 199-205(1970).

From 16th International Conference on Astrophysics, Liege, Belgium. See CONF-690653.

Calculations are presented that represent a first approximation to the solution of the time-dependent equations of stellar structure, including the effects of nonuniform structure. The results are limited to the radiative portion of the quasi-static contraction tracks of stars in the range 3 to 12 $M_\odot$. (W.D.M.)

24716 MASS LOSS FROM $2_\odot$ ROTATING PREMAIN-SEQUENCE STARS. Nobili, L.; Secco, L. (Univ., Padua). Mem. Soc. Roy. Sci. Liege; 19: 207-11(1970).

From 16th International Conference on Astrophysics, Liege, Belgium. See CONF-690653.

In an attempt to interpret some phenomenological aspects of mass loss from contrasting stars, a study was made of a set of stellar evolutionary models with different masses, which happen to be unstable against rotation in the phases of pre-main sequence contraction, by choosing angular momentum as a free parameter. A model of 2 $M_\odot$ with extreme Population I chemical composition is considered. (W.D.M.)

24717 GROWTH OF PLANETESIMALS IN NEBULAE SURROUNDING YOUNG STARS. Hartmann, William K. (Univ. of Arizona, Tucson). Mem. Soc. Roy. Sci. Liege; 19: 215-27 (1970).

From 16th International Conference on Astrophysics, Liege, Belgium. See CONF-690653.

The theory of growth of grains by accretion is combined with studies of the physical chemistry of the solar nebula by Larimer (1967) and Larimer and Anders (1967). It is argued that bodies of planetary mass will grow solely as a result of accretion (and in the early stages by condensation). There are several stages. Iron grains condense and grow by accretion to radius about 10^{-5} cm; then silicates condense on these iron nuclei and grow by accretion to radius about 10^{-1} cm; then ices condense. These icy planetesimals then grow by accretion to radii on the order of 10^7 cm in 10^7 to 10^8 years, when a critical radius is reached where gravitation dominates the accretion processes. The planets so produced sweep up the remaining planetesimals and fragments of planetesimals. The accretion theory satisfies a number of astrophysical and planetary observations. It is pointed out that cocoon nebulae are ideal locales for the production of interstellar grains; they may be as suitable as the atmospheres of cool giant stars advocated by Wickramasinghe (1961). Indeed, the present theory predicts production of grains with iron nuclei and silicate mantles and radii of 3×10^{-5} cm. (auth)

24718 RELATIONSHIP BETWEEN STAR FORMATION AND NUCLEOSYNTHESIS OF THE LIGHT ELEMENTS. INTRODUCTORY REPORT. Reeves, Hubert (Institut d'Astrophysique, Paris. SEP, Saclay, France. Univ. of Montreal). Mem. Soc. Roy. Sci. Liege; 19: 235-45(1970).

From 16th International Conference on Astrophysics, Liege, Belgium. See CONF-690653.

The various theories of the formation of the light elements (Li, Be, and B) are classified according to their main characteristics. The theories are discussed in terms of nuclear physics data and stellar observations. (W.D.M.)

24719 INITIAL Li AND Be CONTENT OF MAIN-SEQUENCE STARS. Conti, Peter S. (Univ. of California, Santa Cruz). Mem. Soc. Roy. Sci. Liege; 19: 261-3(1970).

From 16th International Conference on Astrophysics, Liege, Belgium. See CONF-690653.

The state of our present knowledge of initial Li and Be content of main-sequence stars is discussed. (auth)

24720 OBSERVATIONS: INTRODUCTORY REPORT. Reddish, V. C. (Royal Observatory, Edinburgh). Mem. Soc. Roy. Sci. Liege; 19: 283-94(1970).

From 16th International Conference on Astrophysics, Liege, Belgium. See CONF-690653.

Dark globules are thought to be close to the boundary between interstellar clouds and protostars, and they are discussed in an attempt to form a link with the dust-embedded stars and compact H II regions, infrared and OH sources, T-Tauri stars, and Wolf-Rayet stars. (W.D.M.)

24721 PHOTOELECTRIC SPECTRUM SCANNER OBSERVATIONS OF T TAURI STARS. Kuhi, Leonard V. (Univ. of California, Berkeley). Mem. Soc. Roy. Sci. Liege; 19: 295-303 (1970).

From 16th International Conference on Astrophysics, Liege, Belgium. See CONF-690653.

A brief report is given on photoelectric scanner observations of a number of T Tauri stars obtained over the last few years at Lick Observatory. Measurements were obtained with the 120-inch reflector using the Wampler scanner and ITT FW 130 (S-20) and RCA 7102 (S-1) photomultipliers. Continuum points and emission line fluxes were measured with exit slits of 48 Å for $\lambda \leq 5100$ Å and 64 Å for $\lambda \geq 5100$ Å, covering the wavelength range from 3200 to 11,100 Å. (W.D.M.)

24722 PHOTOGRAPHIC AND PHOTOELECTRIC SURVEY FOR INFRARED STARS IN THE GALACTIC PLANE. Ackermann, G. (Landessternwarte, Heidelberg). Mem. Soc. Roy. Sci. Liege; 19: 307-10(1970).

From 16th International Conference on Astrophysics, Liege, Belgium. See CONF-690653.

Over the past few years, several survey programs for infrared stars have been carried out. The results of the CIT group and of the LPL/Tonantzintla group are well known and partly published. An attempt was made to find new infrared stars and to get an impression of their frequency in selected fields. The question is to know whether the frequency of infrared stars is correlated with the distribution of interstellar matter. (W.D.M.)

24723 T TAURI STARS AND NEUTRAL HYDROGEN: SOME RESULTS OF 21-CM OBSERVATIONS. Sancisi, R. (Sterrenkundig Laboratorium Kapteyn, Groningen, Netherlands. Netherlands Foundation for Radio Astronomy, Amsterdam). Mem. Soc. Roy. Sci. Liege; 19: 313-18(1970).

From 16th International Conference on Astrophysics, Liege, Belgium. See CONF-690653.

With the 25-meter radiotelescope at Dwingeloo, surveys of neutral hydrogen were made in the regions of stellar associations at intermediate galactic latitudes. In the region of the reflection nebula NGC 2068, the hydrogen distribution shows a maximum of peak brightness temperature and a minimum of velocity width near a group of T Tauri stars. Preliminary results on the H I distribution in the Taurus region are also reported. (auth)

24724 SPECTROSCOPIC AND PHOTOMETRIC STUDY OF T TAURI-LIKE STARS AND PECULIAR OBJECTS. Mendoza V, Eugenio E. (Univ. of Mexico, Mexico City. Univ. of Chile, Santiago de Chile). Mem. Soc. Roy. Sci. Liege; 19: 319-24(1970).

From 16th International Conference on Astrophysics, Liege, Belgium. See CONF-690653.

Spectroscopic and photometric observations of fifteen T Tauri-like stars and peculiar objects were used to derive spectral types, intrinsic colors, bolometric corrections, and effective temperatures. Most of the spectra are very difficult to classify in the MK system, because of peculiarities. The derived data were used to construct a Hertzsprung–Russell diagram for these objects. An interpretation is that the majority of the objects under study are premain-sequence stars more massive than the Sun and that they are not in the wholly convective stage of gravitational contraction. (auth)

24725 SPECTRAL ANALYSIS OF LIGHT CURVES OF T TAURI STARS AND OTHER CELESTIAL OBJECTS. Plagemann, Stephen (Inst. of Theoretical Astronomy, Cambridge, Eng.). Mem. Soc. Roy. Sci. Liege; 19: 331-53(1970).

From 16th International Conference on Astrophysics, Liege, Belgium. See CONF-690653.

The purpose of computing power spectra from the complicated light curves of irregular variable stars is to reveal any inherent periodicities that may be obscured by noise. The power spectra can give estimates of the period and amplitude of any periodicities, in addition to the proportional changes in power per unit frequency interval at different vibrational frequencies. Topics discussed include the time domain (time series and autocorrelations), fourier analysis of deterministic processes, power spectrum of a stochastic process, smoothed spectral estimates, and spectral estimates for T Tauri stars and quasar redshifts. (W.D.M.)

24726 COLD NEUTRAL HYDROGEN ASSOCIATED WITH THE DARK CLOUD NEAR θ OPHIUCHI. Simonson III, S. Christian (Leiden Observatory). Mem. Soc. Roy. Sci. Liege; 19: 363-4 (1970).

From 16th International Conference on Astrophysics, Liege, Belgium. See CONF-690653.

The neutral hydrogen in the self-absorption feature in the direction of the dark cloud near θ Ophiuchi was found to have an average temperature 40°K, velocity 4.2 km/s, optical depth 2.3, velocity dispersion 1.2 km/s, and column density of neutral hydrogen 5.0×10^{20} cm^{-2}. In the center, where the obscuration reaches 4.0 m_{pg}, the temperature may be 2°K lower than in the outer regions. At a distance 250 pc, the mass of neutral hydrogen is 675 $M_\odot$ and the mass of dust is 62 $M_\odot$. (auth)

24727 PROBABLE CONNECTION BETWEEN WR STARS AND STAR FORMATION. Schmidt-Kaler, Th. (Ruhr-Univ., Bochum, Ger. Astronomisches Institut, Bochum, Ger.). Mem. Soc. Roy. Sci. Liege; 19: 365-7(1970).

From 16th International Conference on Astrophysics, Liege, Belgium. See CONF-690653.

The K–W–P mechanism to produce the W–R phenomenon by post-main-sequence mass exchange of massive binaries may well explain one half of the WR stars observed, the binaries. To explain the observed characteristics of the other half of the WR stars (definitely single), however, another instability mechanism seems necessary, possibly pulsational instability of very large masses by way of radiation pressure in resonance lines and/or shock waves, in the outermost layers. Single, nonbinary, WN stars seem to initiate a considerable part of the star formation in the Galaxy on spherical or spheroidal shells of stars. These two points are briefly discussed. (W.D.M.)

24728 LUMINOSITIES, TEMPERATURES, AND KINEMATICS OF K-TYPE DWARFS. Eggen, O. J. (Australian National Univ., Canberra). Astrophys. J., Suppl. Ser.; 22: No. 191, 389-417(Mar 1971).

UBVRI observations of some 400 K-type dwarfs were used to examine the kinematics and the population distribution of these stars. Observations of members of the Hyades Cluster and the Wolf 630 and 61 Cygni groups were used to construct (M_I, R – I) relations for young disk and evolved old disk stars as well as correlations between (R – I), (B – V), and (U – B). The main conclusions were that (a) the usually adopted slope of the $\Delta(U-B)/\Delta(B-V)$ relation for the redder stars may be overestimated; (b) there are subdwarfs in the (temperature-bolometric luminosity) plane, but stars with the largest ultraviolet excess occur both among the subdwarfs and old disk objects; (c) the displacement of the main sequences of the subdwarf and old disk objects is not the result of heavy-element abundance alone; and (d) relatively large ultraviolet deficiencies occur among a significant percentage of stars in the present sample, but the largest values, which would represent metal abundances greater than 2 or 3 times that of the Sun, may result from variations from star to star in the microturbulent velocity. The relations between existing (R, I) systems and the photometric discrimination between giants and dwarfs are also briefly discussed. (auth)

24729 STELLAR OLD AGE. II. NEUTRON STARS AND PULSARS. Hammond, Allen L. Science; 171: 1133-4(19 Mar 1971).

Of the postulated end states of stellar evolution, neutron stars have received the most attention in the last few years. The situation since 1967 is briefly discussed, and neutron-star structure and magnetic-field effects are considered. (W.D.M.)

24730 STELLAR OLD AGE: WHITE DWARFS, NEUTRON STARS, AND BLACK HOLES. Hammond, Allen L. Science; 171: 994-5(12 Mar 1971).

The white dwarf is the best understood of the stellar end states and is the only one of the three end states for which there has been any experimental confirmation of theoretical ideas. A short discussion is given on properties of white dwarfs. (W.D.M.)

24731 MEASUREMENT OF BINARY STARS IN NICE WITH A 50 AND 74 cm TELESCOPE. Couteau, Paul (Observatoire, Nice). Astron. Astrophys., Suppl. Ser.; 3: No. 1, 51-69(Nov 1970). (In French).

The results of 491 measurements of 176 binaries made at the 50-cm refractor and of 117 measurements of 46 binaries made at the 74-cm refractor are presented. The latter telescope, which has been completely renewed, has been in operation since May 1969; its free aperture is 737 mm, its focal length 17.89 m at λ = 5461 Å. One revolution of the micrometer screw equals 5.765". (auth)

24732 MEASUREMENT OF VISUAL BINARY STARS. Morel, Pierre Jacques (Observatoire, Nice). Astron. Astrophys., Suppl. Ser.; 3: No. 1, 71-83(Nov 1970). (In French).

The results of 435 measurements of 152 binaries made at the 50-cm refractor, and of 61 measurements of 25 binaries made at the 74-cm refractor of Nice Observatory, are presented. Residuals with respect to known orbits have been computed. (auth)

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24733 V605 AQUILAE: AN EXTRAGALACTIC SUPERNOVA Bidelman, William P. (Case Western Reserve Univ , Cleveland) Astrophys. J.; 165: L7-8(1 Apr 1971).

It is suggested that the enigmatic variable V605 Aquilae, bright in 1919, was a supernova. Its position agrees well with that of Aql XR-1 and also with that of the extended radio source DA 476. If it was indeed a supernova, then it seems clear that the object was extragalactic; but aside from the radio source there is little or no evidence of the parent galaxy. (auth)

24734 NATURE OF THE FIELD BLUE-STRAGGLER STARS. Bond, Howard E. (Louisiana State Univ., Baton Rouge); MacConnell, Darrell J. Astrophys. J.; 165: 51-5(1 Apr 1971).

Four-color photometry shows that the field blue stragglers of Population II have normal surface gravities, and hence normal masses, for their locations in the H–R diagram. This, combined with the high incidence of spectroscopic binaries among these stars, strongly supports McCrea's suggestion that the blue stragglers are the secondaries of close-binary systems, which have moved up the main sequence as mass was transferred to them from the evolving primaries. (auth)

24735 VISUAL INTRINSIC POLARIZATION AND INFRARED EXCESS OF COOL STARS. Dyck, H. M. (Kitt Peak National Observatory, Tucson, Ariz.); Forrest, W. J.; Gillett, F. C.; (and others). Astrophys. J.; 165: 57-66(1 Apr 1971).

Observations of intrinsic polarization and infrared photometry of approximately sixty late-type stars were combined. A relation is shown to exist in the data between measured intrinsic polarization and amount of infrared excess at 11 μ. A theory is derived which explains this relationship and which shows that polarization and infrared excess are related through the scattering and absorption optical depths of a circumstellar cloud of solid particles. The characteristics of the scattering particles are discussed by applying the theory to the data. (auth)

24736 ABUNDANCE ANALYSES OF POPULATION II VARIABLE STARS. I. W VIRGINIS. Barker, Timothy; Baumgart, Leona D.; Butler, Dennis; (and others) (Univ. of California, Santa Cruz). Astrophys. J.; 165: 67-86(1 Apr 1971).

From curve-of-growth analysis, abundances (relative to the Sun) of spectroscopically conspicuous metallic elements were estimated in the archetypal Population II Cepheid W Virginis. The Fe abundance was confirmed by the use of fine analysis based on LTE model atmospheres. The mean metallic abundances, derived from three spectrograms well distributed in temperature around the cycle, are $[N_{non\text{-}s}] = -1.1$ and $[N_s] = -2.2$, where "s" refers to elements produced by the s-process and "non-s" to all other species. It is likely that the excessive metal deficiency of s-process elements reflects the composition of the primeval interstellar medium out of which W Vir was formed. It is shown that the reduction in the metal/hydrogen ratio to one-tenth of the solar value leads to an affirmative test of the shock-wave model for the pulsations. (auth)

24737 NUCLEOSYNTHESIS IN SUPERNOVA MODELS. II. THE ^{12}C DETONATION MODEL. Arnett, W. David (Inst. Theoretical Astronomy, Cambridge, Eng. Rice Univ., Houston, Tex.); Truran, J. W.; Woosley, Stanford E. Astrophys. J.; 165: 87-103(1 Apr 1971).

The predictions of nucleosynthesis resulting from Arnett's ^{12}C-detonation model of supernovae are examined quantitatively. For the first time the change in composition is integrated explicitly through expansion and "freeze-out" for a plausible model of stellar explosion. The predicted abundances are in excellent agreement with the iron-group abundances observed in the solar system (provided the "meteoritic" value for iron is used). An important, hitherto-unknown nucleosynthesis effect is discovered that promises to explain the high-Z side of the iron abundance peak. However, even though the iron-group abundances are well reproduced, this model fails to produce sufficient quantities of intermediate-Z material, that is, species with $6 \leq Z \leq 21$. Thus the model appears to be inconsistent with a combination of standard models of galactic evolution and the observed constancy of metal abundances relative to iron in stars of varying metal content. To avoid this inconsistency a supernova model should produce nearly all the elements between $6 \leq Z \leq 28$ (at least) in the proper ratios. The implications of these calculations for other supernova models, for galactic evolution, and for nucleosynthesis theory are discussed in detail. (auth)

24738 DETERMINATION OF THE LOWER MASS LIMIT FOR THE MAIN SEQUENCE. Straka, W. C. (Univ. of California, Los Angeles). Astrophys. J.; 165: 109-19(1 Apr 1971).

Detailed calculations were carried out for low-mass main-sequence stars to determine their position in the color–magnitude diagram as a function of several boundary parameters. The equation of state included effect of pressure ionization, with an Aller mix composition, the ionization balance being included in detail for hydrogen, helium, and the first three ionization stages for carbon, nitrogen, oxygen, and neon. The H_2 molecule was also included in the envelopes. Cox opacities were used throughout, except in the variations which used the Auman–Bodenheimer H_2O opacities in the envelopes. The envelopes were integrated with a mixing-length formulation by using nongray atmospheres by Gingerich, Latham, Linsky, and Kumar for starting values, to provide a grid of outer boundary conditions for two values of l/H_p where the Auman H_2O opacities were used, and with $l/H_p = 1$ with Cox opacities. The interiors were calculated by a relaxation-method formulation. The models are found to be essentially polytropic in the interior, but show large departures near the surface, as expected. The models with $l/H_p = 1$ and Cox opacities only are hotter than the observed main sequences of Johnson and Limber, with a critical mass limit of 0.082 $M_\odot$. Inclusion of Auman H_2O opacities makes the main sequence only slightly cooler and lowers the critical mass to 0.081 $M_\odot$; whereas, extending the mixing length increases both surface temperature and luminosity, and requires 0.089 $M_\odot$ as the limiting mass. The small effect on the value of critical mass is due to the extreme sensitivity of the nuclear-reaction rate to temperature, which in turn depends on the rapid onset of degeneracy with decreasing mass. (auth)

24739 NONLINEAR PULSATIONS OF UNSTABLE MASSIVE MAIN-SEQUENCE STARS. II. FINITE-AMPLITUDE STABILITY. Talbot, Raymond J. Jr. (Rice Univ., Houston, Tex.). Astrophys. J , 165: 121-38(1 Apr 1971).

Nonlinear pulsations of main-sequence stars of 10^2, 10^3, and 10^4 $M_\odot$ were investigated by a numerical approximation technique. The pulsations grow to a finite limiting amplitude; the stabilizing mechanism is the dissipation of kinetic energy by shock waves. No pulsationally induced mass loss is indicated. Under the assumption that there are no other mechanisms for mass loss, the mean properties of the stars are the same as if they were stable, i.e., bright, very blue O-type stars. For all three masses the limiting amplitudes are $(\delta r/r)_c \sim 0.1$, and the ratios of the maximum surface velocity to the escape velocity are also about 0.1. The qualitative result, finite-amplitude stability, is not influenced by the errors introduced by the approximation. The quantitative errors in the amplitudes are estimated to be less than a factor of 2. The lack of mass loss is a consequence of insufficiently detailed zoning. The astrophysical significance of these results and the consequences of mass loss are discussed. (auth)

24740 LIFETIME MEASUREMENTS AND ABSOLUTE OSCILLATOR STRENGTHS FOR SOME VACUUM-ULTRAVIOLET TRANSITIONS IN O I AND O II. Smith, William Hayden (Princeton Univ., N. J.); Bromander, J.; Curtis, L. J.; Berry, H. G.; Buchta, R. Astrophys. J.; 165: 217-21(1 Apr 1971).

Radiative lifetimes were measured for some resonance transitions of O I and O II in the vacuum-ultraviolet by using the beam-foil method. These results are compared with values in the literature, and an assessment of accuracy is made. (auth)

24741 STELLAR ROTATION: A COMPARISON OF RECENT RESULTS. Jackson, Stephen (Univ. of Colorado, Boulder); Sanderson, A. D.; Smith, R. Connon; Hazlehurst, J. Astrophys. J.; 165: 223-4(1 Apr 1971).

A discrepancy between two recent papers is pointed out and resolved. (auth)

24742 NEUTRON STARS. Lectures Given at the Niels Bohr Institute and NORDITA, Copenhagen. Baym, Gordon. Copenhagen; NORDITA (1970). 74p.

various aspects of the composition of neutron stars are discussed. The macroscopic data relevant for identifying the pulsars to neutron stars are reviewed in the introduction. In a chapter on the atmosphere of the neutron stars it is shown that the ^{56}Fe in the outermost layer is a gas which, immediately under the surface, becomes a fully ionized plasma. The crust of the star, starting only 10 m below the surface, is discussed first from a nuclear physics point of view. The equilibrium β-decay — inverse β-decay processes are discussed (thus equilibrium is pushed far away from the stability line into the extreme neutron-rich region by the degenerate Fermi sea of electrons) together with the nuclear reactions gradually building up heavier nuclei up to ^{118}Kr, at which point extra neutrons added will have no binding energy, and will thus drop off. Instead, they show up as individual neutrons gradually forming a Fermi sea of neutrons as the density gets high enough. The problem of finding an appropriate mass formula for nuclei in this extreme neutron-rich region is discussed. The neutron liquid and the hyperonic core are discussed briefly, and the crust is also discussed from a solid-state point of view. The electrical con-

ductivity is derived and used for estimating the lifetime of the magnetic field. Finally, it is shown that the neutron and proton fluids in the interior are very likely to be superfluid. The formation of vortices and their connection with the macroscopic rotation of the star are discussed. (Denmark)

24743 EVOLUTION OF LOW-MASS STARS. Eggleton, Peter P. (Inst. of Theoretical Astronomy, Cambridge, Eng.). Mon. Notic. Roy. Astron. Soc.; 151: 351-64(1971).

A method is presented for computing the evolution of low-mass stars from the main sequence to the helium flash. Many such computations are handicapped by the fact that the hydrogen-burning shell source becomes very thin at a relatively early stage of evolution, and this means that either a very short time step is needed on the red-giant branch, or else that some special method must be introduced. The present method has neither handicap: the same procedure is used whether there is a thin shell or not, and the time step can be chosen so that the overall structure of the star changes by a fixed small amount per step. About 100 or 150 steps are necessary to evolve a star to the helium flash. The basic features of the method are that the structure equations are solved using a non-Lagrangian mesh, so that a thin shell if it exists can move slowly through the mesh, even if it moves rapidly with respect to the mass coordinate; and that the composition and the mesh are solved simultaneously with the structure equations, giving greater stability and self-consistency. Although the work described here does not take account of convective mixing of composition, it is suggested that a simple generalization of the equations used here would give a reasonable treatment of both convective and semi-convective mixing, if they occur. (auth) (UK)

24744 SKEWNESS OF THE RADIAL VELOCITY CURVE OF A PULSATING MASSIVE STAR: A SURFACE EFFECT. Murphy, J. O. (Monash Univ., Clayton, Victoria). Aust. J. Phys.: 24: 125-6(1971).

The form of the radial velocity curve interior to the stellar surface of a massive star is established for a point $x = r/R$ as $\dot{q}(\tau) = \Sigma_{i=1}^{n} \eta_i(x)\dot{q}_i(t)$. Calculations for $0.60 \leq x \leq 1.00$ for stars M = 15 and 30 are presented. (Australia)

24745 NEUTRON STAR MATTER SUPERFLUIDITY AND SUPERCONDUCTIVITY. Oestgaard, E. (Institut Max von Laue-Paul Langevin, Garching, Ger.). Z. Phys.; 243: 79-91 (1971).

The possibility of superfluidity or superconductivity in neutron or proton subsystems in the nuclear-matter region in neutron stars is investigated. The energy gap and corresponding critical temperature and critical magnetic field is calculated or estimated as a function of density or Fermi momentum. In the calculations reaction matrix elements calculated earlier by means of Brueckner theory are used. The final results indicate that neutron superfluidity, corresponding specifically to S-state pairing, may exist in a low-density shell in the nuclear-matter region of a neutron star. There is probably anisotropic neutron superfluidity, corresponding to the $^3P_2$ or the singlet D state, for higher densities. Superfluidity or superconductivity, corresponding to S-state pairing for the proton subsystem, is quite likely in most of the nuclear-matter region. The expected temperatures and magnetic fields in neutron stars seem to be well below the estimated critical temperatures or critical magnetic fields corresponding to the calculated values of the energy gap. However, similar methods have earlier predicted a much-too-high critical temperature for liquid ^{3}He. (auth)

24746 PARTICLE DIFFUSION AND OVERABUNDANCES OF HEAVY ELEMENTS IN PECULIAR A STARS. Watson, William D. (Cornell Univ., Ithaca, N. Y.). Nature (London) Phys. Sci.; 229: 228-9(22 Feb 1971).

Although it is known that diffusion in the photospheres of peculiar A (Ap) stars accounts for the observed anomalies in element abundances, this article considers whether the extreme overabundance of heavy elements such as Eu and Hg is also consistent with diffusion. Many heavy elements in Ap atmospheres are overabundant by factors of 10^3 while some (Eu and Hg) are overabundant by 10^5. (UK)

24747 POLARIZATION WITHIN THE INTERSTELLAR 4430-A ABSORPTION BAND. Wickramasinghe, N. C. (Cambridge Univ., Eng.); Nandy, K. Nature (London) Phys. Sci.; 229: 234-6 (22 Feb 1971).

The wavelength dependence of interstellar polarization for the star HD 198478, which shows a conspicuous band-like feature in a wavelength region coincident with the 4430 Å interstellar absorption band, is discussed. It is suggested that if the carriers of the λ4430 band occur in optically asymmetric particles that are aligned, it is entirely reasonable to expect that the extinction profile of this band is in fact polarized in the same sense and direction as the star-light continuum outside the band. To test this hypothesis, silicate particles in the form of slender needles whose radii are small compared with their length are considered. For the set of models considered, an impurity concentration is required such that, if Fe^{3+} is the agent responsible for the band, it is within the range permitted by cosmic abundances. Also, the range of silicate particles implied in this model is consistent with the values required to account for the mean wavelength dependence of interstellar polarization and also with the values adopted to match the observed interstellar extinction law on the basis of graphite, iron, and silicate grain mixtures. (UK)

24748 COLLAPSED OR NEUTRON STAR COMPANIONS OF BRIGHT STARS. Woolf, N. J. (Univ. of Minnesota, Minneapolis). Nature (London); 230: 39(5 Mar 1971).

This possibility is examined with special reference to the case of Epsilon Aurigae which, it has been suggested, has a collapsed star as companion and which is one of several binary stars having large mass functions and invisible secondaries. The possibility of mass exchange in such systems is considered, the visible star having been stripped down to its hydrogen core by transfer of matter into the vicinity of a former secondary. With the hydrogen zone, implosion to give a neutron star or a collapsed object might be expected to occur. The approaches suggested might increase progress of knowledge of the physical properties of neutron stars and collapsars. (UK)

Quasi-Stellar, Radio, and X-Ray Sources

24749 (UCID-15622) ILLUSTRATED CATALOGUE OF COSMIC X-RAY SOURCES. Seward, Frederick D. (California Univ., Livermore, Lawrence Radiation Lab.). Feb 1970. 32p. Dep. NTIS.

This catalogue was generated to help understand the published x-ray astronomy data. Emphasis is on galactic sources. Location data are presented on graphs. Sources listed are of varied character ranging from precisely located sources to sources that have only been observed once under rather poor conditions. It includes sources that are highly variable in intensity and spectra. (W.D.M.)

24750 MAPS OF THE DISTRIBUTION OF ATOMIC HYDROGEN IN A REGION IN CENTAURUS. da Rocha Vieira, Edemundo (Instituto Argentino de Radioastronomia, Buenos Aires). Astrophys. J., Suppl. Ser.: 22: No. 190, 369-87(Feb 1971).

A survey was made of the region $302° \leq l \leq 310°$, $2° \leq b \leq 12°$ at the frequency of the hydrogen line. Three elongated features were detected that run parallel to the galactic plane at heights of about 200 pc above it, two of which may be associated with spiral arms in the plane. In addition, a number of very small clouds with negative radial velocities and one cloud with positive radial velocity were observed. (auth)

24751 PLANT, PULSAR, GLITCH, AND WISP. Rees, M. J.; Trimble, V. L. (Inst. of Theoretical Astronomy, Cambridge, Eng.). Nature (London); 229: 395-6(5 Feb 1971).

Observational consequences of the possible existence of a planetary system around NP 0532 are discussed. It is suggested that material evaporated from a planet in an eccentric orbit could be responsible for the brightening of the thin wisp in the Crab Nebula that occurred after the glitch (the period discontinuity observed (Boynton et al. 1969, Richards et al. 1969)) and for the increases of dispersion measure observed during the past year for NP 0532. (UK)

24752 QUASARS OR BLUE STARS. Lii, Philip K. (Yale Univ., New Haven). Nature (London); 229: 477-8(12 Feb 1971).

During investigations of Southern hemisphere radio sources at Yale University Observatory, two 17 × 17 inch plates were exposed simultaneously for two hours followed by a 2-min secondary exposure that covered 6.1 × 6.1°. From examinations of these plates it is suggested that the two radio sources, PKS 0320-37 and 1302-49, usually identified with the galaxies NGC 1316 and NGC 4945 may instead be quasi-stellar sources in the direction of those galaxies. (UK)

24753 DIFFUSE X-RAY BACKGROUND MEASUREMENTS IN THE ENERGY RANGE 2 TO 18 keV. Prakasarao, A. S.; Sharma, D. P.; Jayanthi, U. B.; Rao, U. R. (Physical Research Lab., Navrangpura, India). Astrophys. Space Sci.; 10: 150-5 (Jan 1971).

Rocket measurements of the diffuse x-ray background in the energy range 2 to 18 keV, conducted from Thumba Equatorial Rocket Launching Station (TERLS), India, are presented. The

estimates of the cosmic background are derived by the method that employs the Earth and its atmosphere as a shutter to intercept the celestial x rays. The results are shown to be consistent with a power-law photon spectrum, $13.6^{+4.3}_{-3.3}$ $E^{-1.73\pm0.15}$ photons/cm^2-sec-keV-ster, the spectrum being much flatter than that observed at higher energies. (auth)

24754 POSITIONS OF UNIDENTIFIED RADIO SOURCES. Wade, C. M.; Miley, G. K. (National Radio Astronomy Observatory, Green Bank, W. Va.). Astron. J.; 76: 101-2(Mar 1971).

Accurate positions were measured for 40 unidentified radio sources of small angular size and for two identified sources of particular interest (OQ 208 and VRO 42.22.01 = BL Lacertae). Most of the positions are accurate to ±1 sec of arc in each coordinate. (auth)

24755 OHIO SURVEY SUPPLEMENT 1. Kraus, John D. (Ohio State Univ., Columbus); Andrew, Bryan H. Astron. J.: 76: 103-4(Mar 1971).

A supplementary list of 14 radio sources is given. Most of the sources have flat spectra. (auth)

24756 OBSERVATIONS OF A ROTATING NEUTRAL HYDROGEN CLOUD. Verschuur, G. L. (National Radio Astronomy Observatory, Green Bank, W. Va.). Astron. J.: 76: 105-9 (Mar 1971).

A discrete cloud of neutral hydrogen that may be rotating at 3 km/sec was observed. It is possibly located in the Perseus arm, but is then at a z of 300 pc. Alternatively, it could be an extragalactic H I cloud associated with IC 342. (auth)

24757 POSITIONS OF RADIO SOURCES FROM LONG-BASELINE INTERFEROMETRY. Cohen, M. H.; Shaffer, D. B. (California Inst. of Tech., Pasadena). Astron. J.: 76: 91-100(Mar 1971).

Long-baseline interferometer observations were used to determine the radio positions of 35 compact sources. Positional accuracy was typically 1′ by 3″. The technique involved measuring the time delay between the two stations and the fringe rate. These quantities, and the baseline parameters, were calibrated with measurements on 21 sources that have accurately known positions. The accuracy available with this technique and with present equipment appears limited by the recording bandwidth, by oscillator instabilities, and by the atmosphere. (auth)

24758 STAR FORMATION ASSOCIATED WITH H II REGIONS. Mezger, P. G. (National Radio Astronomy Observatory, Green Bank, W. Va.). Mem. Soc. Roy. Sci. Liege; 19: 325-30(1970).

From 16th International Conference on Astrophysics, Liege, Belgium. See CONF-690653.

Some recent observations made mainly in the radio range of the compact H II region G 209.0-19.4 in the Orion Nebula are discussed. It is believed that these observations are revelant to the problem of star formation. In fact, in some cases one may be observing individual protostars at various stages of the pre-main-sequence stellar evolution. (W.D.M.)

24759 PERIOD AND DECLINATION OF PULSAR MP 0450. Mohanty, D. K.; Balasubramanian, V.; Swarup, G. (Tata Inst. of Fundamental Research, Bombay). Proc. Indian Acad. Sci., Sect. A; 72: 246-8(Nov 1970).

The Ooty radio telescope was used to determine the period, pulse shape, and declination of MP 0450. The declination was −18° 04′ ± 0.5′, and the period was $0.54893509 \pm 1 \times 10^{-8}$ sec. (W.D.M.)

24760 POLARIZATION OF THE SUPERNOVA REMNANT HB 21 AT A WAVELENGTH OF 6 CENTIMETERS. Kundu, M. R. (Univ. of Maryland, College Park). Astrophys. J.; 165: L55-60 (15 Apr 1971).

Linear polarization at 6-cm wavelength was detected in the supernova remnant HB 21. The degree of polarization varied from about 10% to as much as 30% in some regions. A detailed comparison between the map at 6-cm wavelength obtained with a resolution of 6′ of arc and the optical picture of the remnant showed that the general shape and boundary of the optical nebula correspond roughly with the outermost radio contours. Some bright radio spots within the remnant have diffuse optical nebulosities associated with them. (auth)

24761 X-RAY OBSERVATIONS OF THE VIRGO CLUSTER, NGC 5128, AND 3C 273 FROM THE UHURU SATELLITE. Kellogg, E.; Gursky, H.; Leong, C.; (and others) (American Science and Engineering, Inc., Cambridge, Mass.). Astrophys. J.; 165: L49-54(15 Apr 1971).

X-ray emission was observed from the extragalactic objects M87, NGC 5128 (Cen A), and 3C 273. These have all been previously reported as x-ray sources. However, the emission from the direction of M87 extends over a region of more than 1° and may represent the emission from two sources, one being M87 and the other being M84. (auth)

24762 X-RAY SCAN OF THE GALACTIC PLANE FROM UHURU. Giacconi, R.; Kellogg, E.; Gorenstein, P.; Gursky, H.; Tananbaum, H. (American Science and Engineering, Inc., Cambridge, Mass.). Astrophys. J.; 165: L27-35(15 Apr 1971).

This is the first of four Letters reporting preliminary results from the first of NASA's small astronomy satellites, Uhuru. The satellite is designed to conduct a survey of the x-ray sky in the 2- to 20-keV energy range to an ultimate sensitivity of about 5×10^{-4} the flux of the Crab Nebula. A scan of the galactic plane is reported in which twenty-nine discrete sources were seen, of which seven have not been reported previously. (auth)

24763 MEASUREMENT OF THE LOCATION OF THE X-RAY SOURCES CYGNUS X-1 AND CYGNUS X-2 FROM UHURU. Tananbaum, H.; Kellogg, E.; Gursky, H.; (and others) (American Science and Engineering, Inc., Cambridge, Mass.). Astrophys. J.; 165: L37-41(15 Apr 1971).

Based on preliminary data from the x-ray satellite Uhuru, new locations are reported for the x-ray sources Cyg X-1 and Cyg X-2. These are in agreement with previous locations but have significantly smaller error boxes. (auth)

24764 HYDROMAGNETIC FREE EXPANSION OF A RELATIVISTIC GAS. Mathews, William G. (Univ. of California, San Diego). Astrophys. J.; 165: 147-64(1 Apr 1971).

The one-dimensional plane adiabatic expansion of a relativistic plasma is described under a wide variety of situations, including the presence of a cold background plasma and a frozen-in magnetic field. The relativistic plasma is assumed to be monoenergetic, isotropic, and initially uniform. Synchrotron emission from the expanding plasma always appears to be redshifted (with respect to the initial gas) as seen by an observer at rest, and has a spectrum which depends on the amount of cold plasma present. If little nonrelativistic plasma is present, the observer will also see strong limb darkening and center brightening. Equipartition of magnetic and relativistic thermal energies is not preserved in the expansion. Possible application to extragalactic radio sources is briefly discussed. (auth)

24765 FAR-INFRARED EMISSION FROM H II REGIONS. Harper, D. A. (Rice Univ., Houston, Tex.); Low, F. J. Astrophys. J.; 165: L9-13(1 Apr 1971).

Large far-infrared (45 to 750 μ) fluxes were measured from eight sources associated with galactic H II regions. The far-infrared objects are coincident with the thermal radio sources DR 21, K3-50, M17, M42, NGC 2024, W40, and W51. An upper limit was also obtained for the planetary nebula NGC 7027. The far-infrared luminosities of the sources ranged from 2×10^4 to 2×10^7 $L_\odot$. Measurements of M17, M42, NGC 2024, W49, and W51 indicated that the sources are extended, are optically thin, and have temperatures in the range 65 to 120°K. (auth)

24766 H II REGIONS OF SOUTHERN HEMISPHERE. Georgelin, Y. P.; Georgelin, Y. M. (Observatoire, Marseille). Astron. Astrophys., Suppl. Ser.; 3: No. 1, 1-49(Nov 1970). (In French).

Forty-four Hα photographs of H II regions in the southern Milky Way (l^{II} = 250 to 360°) are presented, together with the spectral classification of stars exciting the nebulosities. (auth)

24767 SYSTEM OF PLANETARY MASSES AS ERROR SOURCES IN PULSAR TIMINGS. Mulholland, J. Derral (California Inst. of Tech., Pasadena). Astrophys. J.: 165: 105-7 (1 Apr 1971).

Studies of the intrinsic variation of pulsar frequencies, related to the search for understanding of the physical processes occurring within these objects and to the search for planetary companions, require the reduction of the observations to the barycenter of the solar system. Uncertainties in planetary data will introduce corresponding uncertainties into the pulsar observations. The system of planetary masses, which presents such an error source, is shown to introduce potentially observable effects, but with sufficiently small rates as to represent nearly constant biases over extended periods of time. These effects could be misidentified as evidences of planetary companions, but can have no effect on the value of the braking parameter. (auth)

24768 ABSOLUTE MEASUREMENTS OF THE FLUX OF CASSIOPEIA A AND TAURUS A AT 1.87 CENTIMETERS. Wrixon,

G. T. (Bell Telephone Labs., Inc., Holmdel, N. J.): Gott III, J. Richard: Penzias, A. A. Astrophys. J.; 165: 23-8(1 Apr 1971).

Using the 20-foot horn-reflector antenna at Crawford Hill, absolute flux measurements were made of Cas A and Tau A during April, May, and August 1970. The result for Cas A was 350×10^{-26} W m^{-2} Hz^{-1} with a 99% confidence absolute error of 5.2%, in good agreement with published values. The Tau A data, however, showed a temporal decline of 20% during the period of observation, a change considerably greater than the sum of the known components of experimental error. Published values for the flux of Tau A near this wavelength lie between the maximum and minimum values. (auth)

24769 POSITION OF Cen XR-2 (APRIL, 1967). Francey, R. J. (Univ. of Tasmania, Hobart, Australia). Nature (London) Phys. Sci.; 229: 229-33(22 Feb 1971).

The strongly variable x-ray source Cen XR-2 was first observed from rocket payloads of the Universities of Adelaide and Tasmania (UAT) in April 1967. The results of a re-analysis of UAT flight II on April 20, 1967 are reported. It is shown that the particular rocket motion coupled with the unique intensity of Cen XR-2 at the time permits determination of a galactic longitude for the source $l^{II} = 310.2 \pm 1°$, which is relatively insensitive to possible errors in the rocket attitude solution. A comparison with more-recent x-ray and optical observations yields a positional conflict suggestive of two separate x-ray phenomena. (UK)

24770 VARIABILITY OF CYGNUS X-RAY SOURCES. Francey, R. J. (Univ. of Tasmania, Hobart, Australia). Nature (London) Phys. Sci.; 229: 233-4(22 Feb 1971).

Following recent high-resolution surveys of x-ray sources in regions of high source density, doubt has now been thrown on the previously reported variable nature of many of these sources. An analysis is reported of the intensities at 2 to 8 keV of Cygnus–Serpens sources on April 20, 1967, and it is shown that there is good evidence for variability of a source or sources in the Cygnus region. The count-rate profiles do not support dramatic changes in the the Cyg X-3 and Cyg X-4 intensities. (UK)

24771 INTERPRETATION OF THE OHIO RADIO SOURCE COUNTS. Jauncey, D. L.; Niell, A. E. (Cornell Univ., Ithaca, N. Y.). Nature (London) Phys. Sci.; 229: 223-5(22 Feb 1971).

The results of number–flux density counts for 8,100 sources found in the Ohio radio survey at 1,415 MHz, as compared with other surveys, suggests a systematic error at low flux density. The median value of the bias is of the order of −0.08 f.u. for those sources less than 0.9 f.u. It is stated that correction for the bias depends on a detailed understanding of the cause of this bias and its effect on the measurements. Until this information is forthcoming, statistical studies should be restricted to flux density levels where the effect is insignificant. (UK)

24772 SOME PULSAR SPECTRA IN METER WAVE RANGE. Alekseev, Yu. I.; Vitkevich, V. V.; Zhuravlev, V. F.; Kozhukhov, V. N.; Shitov, Yu. P. (Lebedev Inst. of Physics, Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 13: 1810-13(1970). (In Russian).

Results are given from measuring the spectral indices of the radio emission of CP 1919, CP 1133, CP 0950, and CP 0808. The indices are obtained as a result of averaging the spectral indices of individual pulses. The presence of short periodic variation of the indices with the characteristic time of the order of seconds is shown. (auth)

24773 ESTIMATIONS OF RADIO-EMISSION INTENSITY OF PULSARS CP 0808 AND CP 1133 AT THE FREQUENCY 25 Mc. Bruk, Yu. M. (Inst. of Radiophysics and Electronics, Kiev). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 13: 1814-17(1970). (In Russian).

The pulsars CP 0808 and CP 1133 were observed in the regime of synchronous storage of pulses using the new IRE AS UkSSR radio telescope UTR-2 in 1968–1969. (auth)

24774 OBSERVATION OF THE RADIO EMISSION OF THE PULSAR NP 0532 AT THE FREQUENCY 25 Mc. Bruk, Yu. M. (Inst. of Radiophysics and Electronics, Kiev). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 13: 1818-26(1970). (In Russian).

The radio emission of the pulsar in the Crab Nebula was observed at decameter wavelength using the new IRE AS UkSSR radio telescope UTR-2. The mean energy of the radio emission from the basic pulse and subpulse was measured. The spectral index was estimated, using the data obtained at 196 Mc. (auth)

24775 TIME VARIATIONS OF MAXIMA AND SHAPE OF PULSES OF PULSAR CP 1133. Brezgunov, V. N.; Udal'tsov, V. A. (Lebedev Inst. of Physics, Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 13: 1827-32(1970). (In Russian).

The results of observations of the position of pulse maxima in time for the pulsar CP 1133 made at the frequencies 83, 87, 95, and 103 Mc are presented. It was ascertained that the positions of the pulse maxima are mainly determined by that of subpulses, the distance between subpulses being equal to 33 msec. The position of subpulses with respect to the moments of time corresponding to the main period of pulsations remains unchanged. For observations in the band of 500 kc, approximately 30% of the pulse maxima of the pulsar are moving relative to the given moment. The periodicity of these motions is not observed, therefore there are grounds to assume that in the pulsar CP 1133 the period of the second class is absent. A good correlation in maxima shifts is observed over all given frequencies. The maxima shift effect is explained by the presence of the fine structure of the pulse spectrum due to the physics of the pulse radio emission or the influence of its envelope. This conclusion is confirmed by the observed changes of the pulse shape. It is shown that the scintillations or irregularities cannot be responsible for the observed effects of the maxima shifts and variations of the pulse shape. (auth)

24776 DETECTION AND RESULTS OF INVESTIGATION OF SECOND-CLASS OSCILLATIONS OF SOME PULSARS. Vitkevich, V. V.; Shitov, Yu. P. (Lebedev Inst. of Physics, Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 13: 1833-41 (1970). (In Russian).

Investigations of the variations of the time positions of the pulsar subpulses having led to discovering the periodic second-class process of the pulsar CP 0808 were made using the cross telescope DKR-1000 of the Physical Institute of the Academy of Sciences. Using statistical processing, the periodical second-class process with a period P_2 of about 9 msec was discovered for the pulsar CP 0950. Investigation of the instability of the periodic second-class processes showed that the value of the period P_2 of the pulsars CP 0808 and CP 1919 decreased for a year by 0.02% and 25%, respectively. Based upon the rotatory-pulsating model of the pulsar, the possible parameters of the radio-emitting regions and brightness temperature for CP 0808 and CP 0950 are estimated. (auth)

24777 POLARIZATION OF RADIO EMISSION FROM PULSARS. Zheleznyakov, V. V. (Gorky State Univ.). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 13: 1842-6(1970). (In Russian).

The observed peculiarities of polarization of the radio emission from pulsars may be attributed to emission from the powerful magnetosphere of the neutron star escaping into the interstellar medium with a weak magnetic field. (auth)

24778 SUPERFLUIDITY AND SUPERCONDUCTIVITY OF NEUTRON STARS–PULSARS. Kirzhnits, D. A. (Lebedev Inst. of Physics, Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 13: 1847-51(1970). (In Russian).

A brief critical review is presented of the modern state of the problem on superfluidity and superconductivity of the neutron matter inside pulsars. The data are discussed, as well as theoretical models, enabling one to make a conclusion on superfluidity and superconductivity of the neutron and proton components of pulsar matter. (auth)

24779 TWO GENERATIONS OF PULSARS. Shvartsman, V. F. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 13: 1852-67(1970). (In Russian).

In 10^7 to 10^9 years after the pulsar has been born, the ejection of the material from the neutron star is probably changed into the process of interstellar gas accretion. Under these conditions, pulsars once again flash brightly, but this time owing to accretion. If the magnetic fields of neutron stars decay, then the change of ejection to accretion takes place when $H_0(t) \sim 10^6$ to 10^8 gauss. Plasma oscillations are driven by the shock wave arising from the accretion. The conversion of the oscillations into electromagnetic waves produces the coherent radio emission with a fan-shaped directivity diagram and linear polarization. Conditions for generation of coherent radiation arise also from precipitating plasma at the subpolar regions. This corresponds to a pencil-beam pattern. However, if the magnetic field near the surface of the star does not decay and is sufficiently large ($H_0 \gg 10^8$ gauss), the incident plasma will be carried away by the rotating magnetosphere and ejected along the equator back into interstellar space. The corresponding $v_{ej} \sim c$, and the whole picture looks like Gold's model for young pulsars. The statistics of observations

speak well for the fact that the pulsars observed at the present time represent two groups, i.e., refer to two generations, corresponding to the material ejection and accretion processes. (auth)

24780 PULSARS AS NEUTRON STARS AND WEAK INTERACTIONS. Bisnovatyi-Kogan, G. S. (Inst. of Applied Mathematics, Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 13: 1868-72(1970). (In Russian).

A rapid decrease of the period of pulsars in Vela and Crab is explained due to the neutronization processes in the envelope of the neutron star during the loss of rotational momentum and increase of density. (auth)

24781 GAS HEATING IN THE VICINITY OF PULSARS DUE TO INDUCED COMPTON EFFECT. Levich, E. V.; Syunyaev, R. A. (Inst. of Applied Mathematics, Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 13: 1873-8(1970). (In Russian).

The heating of thermal electrons by low-frequency radiation due to the induced Compton effect has a considerable influence on the thermal balance of the gas around the pulsar. In the close vicinity of pulsars the gas must be relativistic. (auth)

24782 SELF-EXCITED LOW-FREQUENCY OSCILLATIONS OF THE MAGNETIC ROTATING NEUTRON STAR. Vandakurov, Yu. V. (Inst. of Physics and Tech., Leningrad). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 13: 1879-87(1970). (In Russian).

The nonradial low-frequency oscillations of a neutron star with toroidal magnetic field are considered within the framework of the Newton theory of gravitation. The pressure is assumed to be a function of the density only. An approximation method of solving the oscillation equations is developed by means of expansion in spherical functions. It is shown that self-exciting oscillations exist that are asymmetric with respect to the rotation. Whether the instability in question may lead to the occurrence of the pulsating source of radiation is discussed. (auth)

24783 NEW RESULTS IN THE STUDY OF INTERSTELLAR PLASMA USING ITS RADIO PENETRATION BY PULSARS. Vitkevich, V. V.; Shitov, Yu. P. (Lebedev Inst. of Physics, Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 13: 1888-99 (1970). (In Russian).

The data on the fine structure of the spectra of the pulsars CP 0808 and CP 0950 from observations made at 60 and 86 Mc are presented, as well as the parameters of the inhomogeneous structure of the interstellar plasma. It is aimed at the violation of the 4th power law of the dependence of the frequency-correlation radius vs the wavelength. The values of the longitudinal magnetic field determined on the basis of the Faraday effect in observing the pulsars CP 0328 and MP 0628 are equal to 2.7 and 1.6 μGs, respectively. (auth)

24784 DIFFUSION OF RELATIVISTIC ELECTRONS FROM INFRARED SOURCES AND THEIR X-RAY EMISSION. Webster, A. S.; Longair, M. S. (Mullard Radio Astronomy Observatory, Cambridge, Eng.). Mon. Notic. Roy. Astron. Soc.; 151: 261-75(1971).

A model for x-ray sources in which relativistic electrons originate in a compact nucleus which is also a powerful source of infrared emission is analysed. The distortion of the injected electron spectrum due to inverse Compton losses and the spectrum of the resulting x rays are determined for the case in which the propagation of the electrons from the nucleus can be described by a simple diffusion model. It is possible to explain the detailed features of the x-ray background spectrum in the range $0.25 < \epsilon_x < 1000$ keV as the integrated emission from such discrete sources, provided there is little dispersion in the properties of the sources. If Seyfert galaxies are identified with these sources, their infrared spectra should have a maximum about 70 μm, in agreement with observation, and the diffusion coefficients should be $\sim 10^{29}$ cm^{2}s^{-1}, similar to that of cosmic-ray protons in the Galaxy. (auth) (UK)

24785 SEARCH OF THE GALACTIC PLANE FOR HIGH-DISPERSION PULSARS. Large, M. I.; Vaughan, A. E. (Univ. of Sydney). Mon. Notic. Roy. Astron. Soc.; 151: 277-87(1971).

A search of the Southern galactic plane using two "dispersion removers" extends the useful sensitivity of the Molonglo pulsar searches to dispersion measures of 400 cm^{-3} pc. Only two pulsars of dispersion measure exceeding 200 cm^{-3} pc were discovered, suggesting that the slope of the pulsar luminosity function becomes very steep at high luminosities. Calibration data for all the Molonglo searches are presented, so that selection effects among the 29 pulsars discovered at Molonglo can be assessed. (auth) (UK)

Solar Phenomena

Refer also to abstracts 24933 and 24992.

24786 (N-70-35535) FARADAY ROTATION MEASUREMENT OF A 13-cm SIGNAL IN THE SOLAR CORONA. Stelzried, C. T. (Jet Propulsion Lab., Pasadena, Calif.). 15 Jul 1970. Contract NAS7-100. 92p. (NASA-CR-112656; JPL-TR-32-1401). NTIS.

The measurements were made by the Pioneer 6 spacecraft when it was occulted by the Sun during November 1968. During the occultation period, the 2292-MHz S-band telemetry carrier wave underwent Faraday rotation due to the interaction of this signal with the plasma and magnetic field in the solar corona. The rotation phenomena were correlated with decametric solar radio bursts and the implied solar-wind velocity was estimated. The steady-state measurement is compared with a theoretical model of the solar corona, using a modified Allen–Baumbach electron density and the coronal magnetic field derived from the Mount Wilson optical solar magnetograph and the Explorer 33 magnetometer. (auth) (STAR)

24787 HIGH-ENERGY RADIATION ACCOMPANYING THE SOLAR FLARE. Takakura, Tatsuo (Tokyo Univ.); Ito, Kensai. Kagaku (Tokyo); 40: 340-8(Jul 1970). (In Japanese).

Research on high-energy radiation, such as x rays, γ rays, and neutrons, produced from solar flares are reviewed, with emphasis on the contribution of balloon observations in Japan. First, the observational data of high-energy radiations from solar flares are briefly summarized, and the mechanism of their production discussed. A gradual increase of soft x rays accompanying flares is observed and is explained as thermal radiation of a hot plasma. In the hard x-ray region, the increase is impulsive. Balloon observation of the hard x-ray source made on Sept. 27, 1969, showed that the source is smaller than the flare region as observed in Hα emission. Balloon observation in 1968 detected the anomalous increase in γ rays accompanying a radio burst. Various processes for the production of nuclear γ rays by protons accelerated in the flare are discussed. (Japan)

24788 FORECASTING OF THE SOLAR BURST. Tanaka, Haruo (Nagoya Univ., Japan). Kagaku (Tokyo); 40: 349-56 (Jul 1970). (In Japanese).

Forecasting of the solar burst has become of practical importance since space flight was realized. It is also required for systematic observation of related solar phenomena. On the other hand, the research in solar phenomena has advanced rapidly to permit forecasting. This new field is reviewed. Forecasting of the solar flare and various optical phenomena on the solar surface are discussed in relation to the forecasting of proton flares. The gradient of the magnetic field is shown to be an important factor. The ratio of solar radio intensity at 3 to 8cm is closely correlated to proton flares. An international network for the communication of the observed data is briefly described. The reliability of the forecasting is, at most, 75%. Future problems are considered. (Japan)

24789 HELIOSPHERE. Nishida, Atsuhiro (Tokyo Univ.). Kagaku (Tokyo); 40: 432-8(Aug 1970). (In Japanese).

The present state of knowledge concerning the heliosphere is reviewed. The acceleration mechanism of the solar wind, as given by Parker in 1958, is discussed. Several conditions to be satisfied if this mechanism is to work are shown. The angular momentum carried by the solar wind is estimated. It takes 10^{10} years to stop the rotation of the Sun. From satellite observation in 1963 it was found that the magnetic field of the heliosphere is divided into four sectors of alternative direction, and the polarity corresponds to that of the magnetic field on the solar sphere. Indirect means for the observation of the heliosphere are discussed. There are: scintillation of radio waves, shape of the tail of comets, and the disturbance of cosmic rays due to the inhomogeneity of the magnetic field of the heliosphere. From the cosmic-ray observations it is concluded that the inhomogeneity of the field decays at about 5 AU from the Sun. This is in contradiction to the position of the boundary determined from the pressure equilibrium of the solar wind and the interstellar gas. (Japan)

24790 GROWTH OF SOLID PARTICLES IN THE PRIMORDIAL SOLAR NEBULA. Kusaka, Takashi; Nakano, Takenori (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 44: 1580-95(Dec 1970).

Some processes expected to lead to the growth of solid particles in the primordial solar nebula were investigated for two evolutionary phases of the nebula; one is the early phase when the nebula was contracting nearly freely, and the other is the later phase after it flattened into a gaseous disk which is rotating about the protosun. For the free-fall phase, the collision between

grains was found to be too infrequent to lead to their agglomeration for cases where the motion of grains is thermal or where they share the turbulent motion of the gas. For the disk phase, it was found that solid particles can hardly grow to a centimeter size even in 10^9 years if only collisions are considered. However, they are found to sink towards the equatorial plane of the disk in about 10^6 years to form a high-density layer where collisions are greatly accelerated. The time of this sedimentation is independent of the luminosity of the protosun. When the density of this layer becomes greater than the Roche density, fragmentation may occur to form the protoplanets. Finally, the effect of mass ejection from the protosun on the growth of solid particles was investigated. (auth)

24791 FRACTIONATION AND CONDENSATION IN SPACE. Arrhenius, Gustaf; Alfven, Hannes (Scripps Institution of Oceanography, La Jolla, Calif. Univ. of California, San Diego, La Jolla). Earth Planet. Sci. Lett.; 10: 253-67(Jan 1971).

Observations in space suggest that the primordial condensation of solids in the solar system took place from a low-density, partially excited gas and that the gas temperatures were much higher than the temperatures of the solid grains growing from this medium. Laboratory simulation of such condensation processes has provided information on the characteristics of the ensuing solids. The materials in meteorites have properties which in some cases permit, in others strongly suggest or require, the assumption that they are primary and largely unaltered solids grown in extreme thermal disequilibrium with the surrounding gas phase. (auth)

24792 EFFECT OF NEUTRINO MAGNETIC MOMENT ON SOLAR NEUTRINO OBSERVATIONS. Cisneros, Arturo (California Inst. of Tech., Pasadena). Astrophys. Space Sci.; 10: 87-92(Jan 1971).

Neutrino spin precession effects in the magnetic field of the Sun are considered as an explanation of the outcome of Davis' solar neutrino experiments. Theoretically, it is possible to account for a neutrino magnetic moment only as the result of the interaction of the electromagnetic field with charged particles into which the neutrino can transform virtually. The currently accepted theory of weak interactions (the two-component neutrino and V−A interactions) forbids a resulting magnetic moment interaction with the electromagnetic field for all such virtual processes. Modifications of this theory are considered to find out whether an appreciable precession effect is permitted within the experimentally established limits. It is found that the value for the neutrino magnetic moment evaluated under these theoretically anomalous circumstances is still so small that only the largest possible estimate for the magnetic field strength in the Sun's interior would cause the required effect. (auth)

24793 PARTICLE FLUX ASSOCIATED WITH STOCHASTIC PROCESSES. Newman, C. E.; Sturrock, P. A.; Tademaru, E. (Stanford Univ., Calif.). Astrophys. Space Sci.; 10: 102-5(Jan 1971).

The Lagrange expansion, which may be used to derive the Fokker−Planck equation, is used to derive the corresponding expression for the flux of particles subject to a stochastic scattering process. The coefficients that occur in this expression are, in general, not the same as the coefficients that occur in the Fokker−Planck equation itself. In the special case that the particle distribution involves only one independent variable, the particle flux is determined by the familiar Fokker−Planck coefficients. Evaluation of particle flux is of special interest in the study of stochastic acceleration. (auth)

24794 SOLAR-PARTICLE TRACKS IN GLASS FROM THE SURVEYOR 3 SPACECRAFT. Crozaz, G.; Walker, R. M. (Washington Univ., St. Louis). Science; 171: 1237-9(26 Mar 1971).

A glass filter from Surveyor 3 has a surface density of $\sim 1 \times 10^6$ tracks/cm^2 from heavy solar-flare particles. The variation with depth is best fitted with a solar-particle spectrum $dN/dE = 2.42 \times 10^6\ E^{-2}$ [in particles/cm^2/yr/sterad/(MeV/N)], where E is the energy and N is the number of particles, from 2 to ~7 MeV/N and $dN/dE = 1.17 \times 10^7\ E^{-3}$ at higher energies. Not much difference is observed between 0.5 and 5 μ, an indication that there is a lack of track-registering particles below 0.5 MeV/N. The Surveyor data are compatible with track results in lunar rocks, provided an erosion rate of $\sim 10^{-7}$ cm/yr is assumed for the latter. The results also suggest a small-scale erosion process in lunar rocks. (auth)

24795 VERY HEAVY SOLAR COSMIC RAYS: ENERGY SPECTRUM AND IMPLICATIONS FOR LUNAR EROSION. Fleischer, R. L.; Hart, H. R. Jr.; Comstock, G. M. (General Electric Research and Development Center, Schenectady, N. Y.). Science; 171: 1240-2(26 Mar 1971).

The energy spectrum of solar cosmic-ray particles of the iron group was determined for the first time over the energy range from 1 to 100 MeV/N by the use of glass removed from the Surveyor 3 spacecraft. The difference between the observed energy spectrum and the limiting spectrum derived previously from tracks in lunar rocks gives an erosion rate of 0 to 2 angstroms per year. High-energy fission of lead, induced by galactic cosmic-ray protons and alpha particles, was also observed. (auth)

24796 EVOLUTION OF THE SOLAR CORONA DURING THE CONTRACTION PHASE. De Loore, C. (Univ., Brussels). Mem. Soc. Roy. Sci. Liege; 19: 153-60(1970).

From 16th International Conference on Astrophysics, Liege, Belgium. See CONF-690653.

Models of stellar coronas were calculated for stars with effective temperatures between 3700 and 8300°K for various log g-values. For the Sun, a coronal temperature of 1.3×10^{6}°K was found and an electron density at the base of the corona of $10^{9.4}$. When taking into account the inhomogeneous structure of the chromosphere, these values are reduced to: $T_{cor} = 1.1 \times 10^{6}$°K and $N_e = 1.6 \times 10^{9}$. For stars with effective temperatures lower than 3700°K no corona at all was found, or only a temperature rise of some hundreds of thousands degrees. So one may conclude that, in the earlier stages of solar evolution, there was no corona (life times between zero and 10^7 years). For the later stages the following values were found: 10^7 years: $T_{eff} = 3750$°K, log g = 3.85, $T_{cor} = 1.5\ 10^6$, log $N_e = 9.12$; 10^8 years: $T_{eff} = 5300$°K, log g = 4.48, $T_{cor} = 0.9\ 10^6$, log $N_e = 9.68$; and $4.5\ 10^9$ years: $T_{eff} = 5800$°K, log g = 4.45, $T_{cor} = 1.3\ 10^6$, log $N_e = 9.80$. (auth)

24797 DEUTERIUM IN THE SOLAR PHOTOSPHERIC SPECTRUM. Grevesse, N. (Univ., Leige). Mem. Soc. Roy. Sci. Liege; 19: 249-54(1970).

From 16th International Conference on Astrophysics, Liege, Belgium. See CONF-690653.

A search for the presence of deuterium lines in the blue wings of Hα and Hβ was made by analyzing new solar tracings in the region of Hα and Hβ recently obtained at the Jungfranjoch station. (W.D.M.)

24798 FORMATION OF DEUTERIUM IN THE EARLY SOLAR SYSTEM. Audouze, Jean (Institut d'Astrophysique, Paris. Service d'Electronique Physique, Saclay, France). Mem. Soc. Roy. Sci. Liege; 19: 255-9(1970).

From 16th International Conference on Astrophysics, Liege, Belgium. See CONF-690653.

Light element (Li, Be, B) abundances in the solar system have been explained by means of high-energy proton fluxes irradiating a gas having solar abundances. If the same origin is attributed to deuterium, the proton flux is not sufficient to explain its observed abundance in the Earth and meteorites. If instead the irradiation took place in a gas having already lost a certain amount of hydrogen, helium, and M elements (C, N, O) the same flux can explain the deuterium abundance as well as light-element (Li, Be, B) abundances. In all cases examined, the irradiation is supposed to take place in a gas a little richer in H, He, C, N, O than the Earth or the meteorites. Thus it can be considered that deuterium has been formed in the beginning of the matter fragmentation in the solar system 4.6×10^9 years ago. (auth)

24799 MAGNETIC FIELD MEASUREMENTS ABOARD THE HELIOS SOLAR PROBE. Neubauer, Fritz Manfred (Technische Univ., Brunswick). Sterne Weltraum; 9: 223-8(Sep 1970). (In German).

Some problems of magnetic-field measurements associated with the Helios solar-probe missions in 1974 and 1975 are discussed. Following a brief review of the Helios project, the properties of the magnetic field and its importance to the physics of the interplanetary medium are discussed. The magnetic field is shown to be not only of major significance for interpreting the characteristics of the interplanetary medium, but also to be indispensable for interpreting all charged-particle observations. Two types of magnetometer systems for measuring the slowly changing interplanetary magnetic-field components are proposed and their operation is explained. The fine structure and the mechanism of shock-free interplanetary shock waves and their effect on the origin of magnetic storms is discussed. For investigating the magnetic fields of interplanetary shock waves, an experiment is proposed in which frequencies are measured up to approximately 2500 Mz by means of an induction-coil magnetometer, characterized in that its sensitivity for magnetic fields increases with frequency. Finally, the problem of magnetic purity is discussed. (IAA)

XUM

24800 TEMPORAL CORRELATION BETWEEN FLARES AND SURGES. Mazzucconi, Fabrizio (Osservatorio Astrofisico, Arcetri, Italy); Righini, Alberto. Soc. Astron. Ital., Mem.; 41: 243-6(Apr-Jun 1970).

The distributions of the time intervals that occur between analogous phases of the evolution curves of solar surges and associated flares are examined. The results obtained confirm those obtained by Drago et al. (1967) concerning the temporal sequence between the start of the flare and the surge. Most probably the delay in the beginning of the surge with respect to the start of the flare is about 5 minutes. However, although the surge does not appear to be associated with the flare in at least 60% of the cases, it was noticed that the reasons that cause the surge occur predominantly at the moment of the flare's maximum. (IAA)

24801 SOLAR ACTIVITY IN 1968. Zlobec, Paolo (Osservatorio Astronomica, Trieste, Italy). Soc. Astron. Ital., Mem.; 41: 205-14(Apr-Jun 1970).

Solar optical and radio data obtained at the Trieste Astronomical Observatory in the year 1968 are discussed. Comments are made on the behavior of the present solar cycle and on the correlation between the optical phenomena and radio activity. In particular, it was observed that it is unlikely that metric-wave bursts are associated with flares located in areas without visible spots in the neighborhood. (IAA)

24802 OBSERVATION OF A SOLAR RADIO BURST BEFORE THE SOLAR ECLIPSE OF MARCH 7, 1970. Felli, Marcello; Tofani, Gianni. (Osservatorio Astrofisico, Arcetri, Italy). Soc. Astron. Ital., Mem.; 41: 251-3(Apr-Jun 1970).

A solar radio burst observed at three wavelengths at the phase of totality of the solar eclipse of Mar. 7, 1970, is described. A summary of the parameters of the burst at the various frequencies is tabulated. The spectrum of the burst appears to be of the C2-type, namely with a sharp maximum at 2800 MHz. (IAA)

24803 ON TWO VERY PECULIAR PHASES OF THE SOLAR TYPE-IV EVENT ON MARCH 2, 1970. Abrami, Alberto (Osservatorio Astronomico, Trieste, Italy). Soc. Astron. Ital., Mem.; 41: 231-4(Apr-Jun 1970).

A radiopolarimetric recording of the flux density and circular polarization behavior of a solar Type-IV event that showed two very peculiar phases of short duration is described. It was found that the quiet-Sun unpolarized and constant radiation cannot explain the observed amount of the polarization variation and that, in the first phase, this variation is not similar to the flux variation but is preferentially present in the negative variations only. These facts may support the assumption that the enhanced emission may consist of an unpolarized constant part and a polarized variable one as well. (IAA)

24804 SOLAR-NEUTRINO FLUX AND STELLAR EVOLUTION WITH MIXING. Shaviv, Giora (Tel-Aviv Univ., Ramat-Aviv, Israel); Salpeter, Edwin E. Astrophys. J.; 165: 171-9(1 Apr 1971).

The effects of hypothetical partial mixing on the solar-neutrino flux are examined, on various time scales and for various fractional masses q_m in the mixed core. The effects of such mixing on early evolution away from the main sequence (H–R diagram of globular or old open clusters) are also examined. It is found that (a) the dependence of evolution on q_m is such that observations on clusters can rule out $q_m \gtrsim 0.4$ (but not $q_m \lesssim 0.2$); (b) irrespective of the speed and type of mixing currents, the solar-neutrino flux is then reduced by a factor of ~1.5 at most. (auth)

24805 TWO-COMPONENT MODEL OF THE QUIET SOLAR WIND WITH VISCOSITY, MAGNETIC FIELD, AND REDUCED HEAT CONDUCTION. Wolff, Charles L.; Brandt, John C.; Southwick, Robert G. (Goddard Space Flight Center, Greenbelt, Md.). Astrophys. J.; 165: 181-94(1 Apr 1971).

Previous models of the quiet solar wind based on steady-state plasma theory do not satisfactorily reproduce the observed properties at Earth. The addition of nonthermal heating cannot provide agreement. Most earlier models neglected viscosity, and it is found that viscosity plays the major role in heating the protons. A model, including viscosity, is presented in which steady-state theory is altered only by the reduction of the electron mean free path—a semi-empirical method for including the effects of plasma instabilities. At 1 A.U., this model has radial and azimuthal velocities of about 300 and 2 km sec^{-1}, respectively; the electron and proton temperatures are 200,000 and 40,000°K; the electron density is 9 cm^{-3}. All are in good agreement with quiet-time observations. (auth)

24806 ABSORPTION SPECTRUM OF Na I IN THE VACUUM ULTRAVIOLET. Connerade, J. P. (European Space Research Inst., Frascati, Italy); Garton, W. R. S.; Mansfield, M. W. D. Astrophys. J.; 165: 203-12(1 Apr 1971).

The absorption spectrum of Na vapor in the region 150 to 600 A was photographed for the first time. At least thirty-eight discrete features were measured, all of which can be attributed to excitation from the $2p^6$ and $2s^2$ shells. Hartree–Fock calculations confirmed some of the assignments, and the positions of the two transitions $2p^63s^2S_{\frac{1}{2}} - 2p^53s^2\ ^2P_{\frac{1}{2}}$ and $^2P_{\frac{3}{2}}$ were compared with the structure of the L_{II} and L_{III} edges in the soft x-ray absorption spectrum of solid sodium. (auth)

24807 BRANCHING RATIOS AND TRANSITION PROBABILITIES IN Fe I. Martinez-Garcia, Mario (California Inst. of Tech., Pasadena); Whaling, Ward; Mickey, Donald D.; Lawrence, George M. Astrophys. J.; 165: 213-16(1 Apr 1971).

Branching ratios were measured for all of the classified transitions from six levels in Fe I above 6 eV for which the lifetimes had been measured earlier by the beam-foil method. Good agreement was found between the transition probabilities derived from these branching ratios and other recent measurements by quite different techniques. A comparison of the results with those of Corliss and Tech indicated that the CT tables yield reliable branching ratios only for the stronger transitions. (auth)

24808 CAPTURE THEORY AND PLANETARY CONDENSATION. Dormand, J. R.; Woolfson, M. M. (Hull Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 151: 307-31(1971).

The condensation of planets under the conditions of Woolfson's capture theory of the origin of the solar system is described. It is shown that material captured by the Sun, during an encounter with another star, would probably not recondense to form planets under the conditions originally specified. Different star encounters are studied using numerical analysis, and it is shown that as a result of a "fast" encounter, the Sun could capture material that would recondense to form planets and take up orbits that are comparable to those observed in the solar system. The probability of such star encounters and, also, the origin of planetary satellites are briefly discussed. (auth) (UK)

24809 OBSERVED ABUNDANCE DISTRIBUTION OF CHEMICAL ELEMENTS AS A TEST OF ALFVEN'S THEORY OF THE ORIGIN OF THE SOLAR SYSTEM. Hauge, O. (Univ. of Oslo). Nature (London); 230: 39-41(5 Mar 1971).

Alfvén suggested that the effect of magnetic fields on the orbits of ions may have been important during the early history of the solar system; neutral atoms and ions would follow different paths, causing a separation effect. In the work described, ionisation energy is the parameter considered, and the abundances of the chemical elements in ordinary chondrites, terrestrial magma, and lunar rocks were compared with solar abundances. Histograms based on 44 elements showed that, in the case of terrestrial magma and lunar rocks, the step curve falls off towards higher ionisation potentials corresponding to relative abundance depletions of 10^{-2} to 10^{-3}, but for elements with low ionisation potentials the terrestrial abundance exceeds that of lunar rocks by a factor of 30. These results support Alfvén's ideas about the formation of the Moon and the Earth. The chondrite abundances appear to be independent of ionisation potential, and these may reflect the composition of the original primordial matter. Amongst conclusions reached are that ionised matter in magnetic fields played an important part in the formation of the Earth and Moon, which were formed under different ionisation conditions. If it is assumed that energy causing the ionisation increases towards the Sun, then the Moon must have been formed on the inner side of the Earth. It is realised, however, that many other physical and chemical properties of matter must be taken into account in a theory for the solar system. (UK)

Galaxies

24810 POLARIZATION MEASUREMENTS IN THE REGION OF THE NORTH GALACTIC SPUR AT 707 MHz. Clarke, Thomas Roy Jr. Toronto; Univ. of Toronto (1969). National Library of Canada, Ottawa.

Thesis.

Results of a survey of polarized radio emission at 707 MHz over the region from α = 12h to 19h and δ = +10° to +40° are presented and analyzed. This region contains the highly polarized area of the North Galactic Spur, a prominent feature of the nonthermal radiation of the Galaxy. Measurements were made with the 10-meter precision paraboloid of the Algonquin Radio Observatory using a two-channel phase-switched polarimeter and crossed-dipole feed. The 707-MHz polarization map of the region of the Spur is consistent with published polarization

maps at 408, 610, and 1407 MHz. There is a large area of uniform polarization centered on $l^{II} = 10°$ $b^{II} = 65°$. The region of uniformity is larger than that at lower frequencies. An apparent spectral index was determined from 707- and 408-MHz (Leiden) data. The plot of index against galactic latitude has a large scatter but there is a correlation between index and latitude. A region of low spectral index was found close to the North Galactic Pole. The apparent spectral index was found to be smaller on the center line of the ridge of the Spur than for regions off the Spur. This was interpreted as the effect of depolarization in the Spur. The change in orientation of polarization vectors along the line of the Spur was used to test models of electron density distribution and local magnetic field. The assumptions used in this analysis were discussed. If the distance to the Spur is 100 pc and if the electron density in the galactic plane is 0.1 cm^{-3}, the magnetic field strength is 7.2×10^{-6} gauss. An attempt to detect polarization in the most strongly polarized region of the Spur at 10-cm wavelength is described. The results indicate an upper limit to the polarization brightness temperature at this wavelength of 0.05°K. (TSS) (Diss. Abstr. Int., B)

24811 FAINT GALAXIES IN THE COMA AND CORONA BOREALIS CLUSTERS. Noonan, Thomas W. (State Coll., Brockport, N. Y.). Astron. J.; 76: 182-9(Mar 1971).

Studies of existing 200-inch plates of the Corona Borealis and Coma clusters give the following results. A large fraction of the detected galaxies are cluster galaxies. The fainter galaxies are less concentrated toward the cluster center than the brighter galaxies for the zone covered by the plates. The slope of the central logarithmic luminosity function is approximately 0.2 to 0.3 at the limit, and the slope of the logarithmic luminosity function for field galaxies is twice as large. The faint galaxies seem to offer no hope in solving the mass problem. Plates of Selected Area 57 show more field galaxies than those in the central region of the Coma cluster, an effect which could be due either to plate differences or to intergalactic absorption in the cluster. This study includes all faint galaxies, not merely the "dwarfs" of other investigators. (auth)

24812 GALACTIC ABSORPTION IN THE ZWICKY CATALOGUE. Noonan, Thomas W. (State Coll., Brockport, N. Y.). Astron. J.; 76: 190-2(Mar 1971).

The galaxy counts in the Zwicky catalogue indicate that galactic absorption, although inhomogeneous, averages to the cosecant law with photographic-magnitude coefficient 0.315 ± 0.023 m. The Shane–Wirtanen results differ because of the faintness of their limiting magnitude. The presence of inhomogeneities makes it necessary to use caution in extrapolating the cosecant law to obtain the polar absorption. The constant C, which appears in the relation $\log n = 0.6m - C$, for the density n in galaxies per square degree to a bright limiting magnitude m is found to be C = 8.69 ± 0.09. (auth)

24813 SPECTRUM OF THE A 76 NEBULA. Chopinet, Marguerite (Bordeaux Univ., Floirac, France. CNRS, Marseille). Compt. Rend., Ser. B; 272: 290-2(25 Jan 1971). (In French).

Spectrographic analysis of the small A 76 nebula revealed that it was not a planetary nebula but a special type of galaxy presenting emission hydrogen lines and the forbidden [O III] and [S II] lines. It has a recession velocity of 3.240 kms^{-1}. (auth) (France)

24814 ORIGIN OF THE GALACTIC HALO. Rood, Herbert J.; Welch, Gary A. (Wesleyan Univ., Middletown, Conn.). Astrophys. J.; 165: 225-6(1 Apr 1971).

A critical discussion is given of some key factors related to the hypothesis that the halo of the Galaxy was formed by (i) gravitational collapse of a gaseous proto-Galaxy or (ii) violent ejection from the galactic nucleus. (auth)

24815 LOW-ENERGY COSMIC RAYS AND THE ABUNDANCE OF ATOMIC HYDROGEN IN DARK CLOUDS. Solomon, P. M. (Columbia Univ., New York); Werner, Michael W. Astrophys. J.; 165: 41-9(1 Apr 1971).

The expected equilibrium abundances of H and H_2 in dark clouds were calculated under the assumption of a "normal" dust-to-gas ratio, formation of H_2 on grains, and ionization and dissociation of H and H_2 by low-energy cosmic rays. It is shown that destruction of H_2 by cosmic rays maintains a significant abundance of H even in dense clouds composed largely of H_2. The column densities of H expected for dust clouds due to these processes are compared with observation. The observed H abundances are below those predicted for dense clouds, and it is concluded that if low-energy cosmic rays exist, they do not penetrate dense clouds. The kinetic temperature inside these clouds may be extremely low (T < 10°K). (auth)

24816 DUST ACROSS MAFFEI 1. Ford, Holland C. (Univ. of Oregon, Eugene); Jenner, David C. Astrophys. J.; 165: L1-2 (1 Apr 1971).

Image-tube photographs reveal an absorption feature near the nucleus of Maffei 1. The feature may be a dust lane in Maffei 1. (auth)

24817 FURTHER SPECTROSCOPIC OBSERVATIONS OF THE NUCLEUS OF THE SEYFERT GALAXY NGC 4151. Anderson, Kurt S.; Kraft, Robert P. (Univ. of California, Santa Cruz). Astrophys. J.; 165: L3-5(1 Apr 1971).

Additional spectroscopic observations were made of the nuclear region of NGC 4151. Comparison with earlier observations indicated changes in the line spectrum that are consistent with a variation in the brightness of the nuclear continuum. The violet-shifted absorption lines observed on March 27, 1969, were still present on April 25, 1970. The principal change in the absorption spectrum is the apparent disappearance of structure in the He I λ3889 absorption. (auth)

24818 POSSIBLE ROTATIONAL EQUILIBRATION OF INTERSTELLAR AMMONIA BY RADIATIVE $\Delta k = \pm 3$ TRANSITIONS. Oka, T. (National Research Council of Canada, Ottawa); Shimizu, F. O.; Shimizu, T.; Watson, J. K. G. Astrophys. J.; 165: L15-19 (1 Apr 1971).

It is pointed out that the probabilities of radiative $\Delta k = \pm 3$ transitions between metastable rotational levels of ammonia are not much smaller than those for collision-induced transitions considered by Townes and his collaborators in the discussion of rotational relaxation of NH_3 in interstellar space. Calculated values of the time of spontaneous emission for such radiative transitions give the upper limits of the lifetimes of metastable levels and provide a useful time standard in interstellar space. Competition between the radiative transitions and the collision-induced transitions are discussed; the discussion uses the calculated values of the former and the laboratory results on the latter. Lower limits for the density of collision partners required to comply with the observation by Cheung et al. are given. (auth)

24819 DETECTION OF X RAYS FROM THE SEYFERT GALAXIES NGC 1275 AND NGC 4151 BY THE UHURU SATELLITE. Gursky, H.; Kellogg, E. M.; Leong, C.; Tananbaum, H.; Giacconi, R. (American Science and Engineering, Inc., Cambridge, Mass.). Astrophys. J.; 165: L43-8(15 Apr 1971).

The detection of significant fluxes of x rays in the range 2 to 6 keV from the Seyfert galaxies NGC 1275 and NGC 4151 is reported. Significant emission from the direction of NGC 1068 was not observed. The positional error on NGC 1275 is 0.01 square degrees; that on NGC 4151 is 0.56 square degrees. (auth)

24820 SEYFERT-TYPE CHARACTERISTICS OF THE NUCLEUS OF NGC 6814. Ulrich, Marie-Helene (Institut d'Astrophysique, Paris. Univ. of Texas, Austin). Astrophys. J.; 165: L61-3(15 Apr 1971).

Spectrographic observations show that the spiral galaxy NGC 6814 has a Seyfert-type nucleus with very wide permitted emission lines and relatively narrow forbidden lines: Hβ is 95 Å wide and [O III] λ5007 is 24 Å wide. (auth)

24821 DISTRIBUTION OF LIGHT IN THE CENTRAL REGIONS OF SOME GIANT ELLIPTICAL GALAXIES. Heeschen, D. S. (National Radio Astronomy Observatory, Green Bank, W. Va.); Morgan, W. W.; Walborn, N. R. Astrophys. J.; 165: L65-6(15 Apr 1971).

Short-exposure photographs of several giant elliptical galaxies show at least two distinctly different distributions of light in the central regions of objects which in other optical respects are similar. There are radio differences among the objects, but more observations are needed to determine whether a correlation exists between the radio properties and light distribution. (auth)

24822 GENERATION OF MAGNETIC FIELDS IN ASTROPHYSICAL BODIES. V. BEHAVIOR AT LARGE DYNAMO NUMBERS. Parker, E. N. (Univ. of Chicago. Max-Planck-Institut fuer Physik und Astrophysik, Munich. Institut fuer Extraterrestrische Physik, Munich). Astrophys. J.; 165: 139-46(1 Apr 1971).

There is the theoretical possibility that some astrophysical objects may have large dynamo numbers, generating fields in high modes. The effect of the boundaries is diminished, and it is profitable to consider the fields in terms of the four basic wave modes of the dynamo. Normal incidence and reflection of dynamo waves from boundaries are worked out. Dynamo wave packets are discussed briefly, and a pseudo-illustration of the solar dynamo is presented. The purpose of the calculations is to

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illustrate some of the behavior at large dynamo numbers, to aid in observational recognition. (auth)

24823 GALACTIC WAKES. Ruderman, M. A.; Spiegel, E. A. (Columbia Univ., New York). Astrophys. J.: 165: 1-15(1 Apr 1971).

The hypersonic flow of intergalactic gas past a spherical galaxy is discussed. Isentropic motion near the downstream symmetry axis is described by a similarity solution to the fluid-dynamical equations. The upstream flow is represented by orbit theory and matched to the fluid flow across a conical shock. The downstream flow exhibits high density and low temperature near the axis. These results are used to estimate the x radiation from galactic wakes. (auth)

24824 DETECTION OF THE GALACTIC NUCLEUS AT ONE MICRON. Spinrad, Hyron; Liebert, James; Smith, Harding E.; Schweizer, Francois; Kuhi, Leonard V. (Univ. of California, Berkeley). Astrophys. J.; 165: 17-21(1 Apr 1971).

The nucleus of the Galaxy, at the position of the Sgr A radio source and the Becklin and Neugebauer infrared maximum, were detected at 11,800 and 10,600 Å. These wavelengths are deep airglow minima that allow the observation at relatively low flux levels, even from the northern hemisphere. The data are consistent with the galactic center having a near-infrared spectrum intrinsically similar to the nucleus of M31 and a large total visual absorption of about 29 mag. This agrees with the conclusion of Becklin and Neugebauer. A search for λ10,830 of He I in emission probably failed. This negative result implies that the galactic center does not have the extreme Seyfert-galaxy line spectrum like the core of NGC 4151. An infrared star, probably unrelated to the galactic nucleus, was found and is briefly discussed. (auth)

24825 INTERSTELLAR DUST: REPLY TO DULEY'S CRITICISMS. Wickramasinghe, N. C. (Cambridge Univ., Eng.); Nandy, K. Nature (London) Phys. Sci.; 230: 24(1 Mar 1971).

Duley's second criticism (Nature Physical Science, 229: 82 (1971)) of the author's hypothesis of graphite–iron–silicate grain mixtures is answered. It is incorrect to say that a fit to the observed extinction curve was only possible with specific mean radii. A wide range of relative proportions of the three grain species and several different types of size distributions have been shown to provide satisfactory fits to the available astronomical data. It is further pointed out that, as well as matching the extinction data, any permissible grain model must satisfy three further restrictions: (1) the postulated grain material should be sufficiently abundant to make up ~1% of the mass of all interstellar matter; (2) it should be sufficiently refractory to persist near hot stars; and (3) it should be able to condense with relative ease in astronomically feasible situations, with a replenishment time scale throughout the Galaxy of $\sim 10^9$ years. These restrictions, taken together with the extinction and other optical data, severely limit the allowable candidates for grain material. Mixtures of graphite, iron, and silicate grains have the attractive property of meeting all these requirements. (UK)

24826 SHAPE OF THE DIFFUSE INTERSTELLAR BANDS. Greenberg, J. Mayo (State Univ. of New York, Albany. Dudley Observatory, Albany); Stoectly, R. Nature (London) Phys. Sci.; 230: 15-16(1 Mar 1971).

Calculations were made of the polarization and extinction in the 4430 Å region produced by several of the proposed interstellar grain models, including silicates and graphites. These results are shown, from which an asymmetry factor α is defined, which is a sensitive method of parameterizing the effect of grain size and optical properties. Thus, a new criterion for distinguishing between grain types, based on the shape of the diffuse bands, is suggested. It should be possible to establish from the shape of the polarization curve whether or not the diffuse bands originate from a constituent of the interstellar grain. (UK)

24827 INTERSTELLAR GRAINS AND THE 200A INTERSTELLAR EXTINCTION FEATURE. Wickramasinghe, N. C. (Cambridge Univ., Eng.); Nandy, K. Nature (London) Phys. Sci.; 230: 16-18(1 Mar 1971).

Arguments are presented against a pure enstatite grain model, though these do not detract in any way from the significance of the new data supplied by Huffman and Stapp (Nature Physical Science, 229: 46(1971)). It is stated that more extensive optical data for a wide variety of types of silicates are badly needed. It is important to know how sensitive the ultraviolet absorption properties are to the specific type of silicate $(MgFe)SiO_4$ chosen, as well as to the impurity content and temperature of the sample. (UK).

Cosmology

24828 SINGULARITIES IN GENERAL RELATIVITY AND COSMOLOGY. Ginzburg, V. L. Comments Astrophys. Space Phys.; 3: 7-12(Jan-Feb 1971).

As is well known, a number of solutions of the equations of general relativity, including those corresponding to different cosmological models and collapse of rather massive stars, have singularities. By true singularities it is meant that the density $\rho \to \infty$ and/or some components of the curvature tensor $R_{iklm} \to \infty$. The relevance of these singularities and of the solutions that possess them are considered. (W.D.M.)

24829 COSMOLOGICAL EVOLUTION IN RADIO GALAXIES. Rowan-Robinson, M. (Queen Mary Coll., London). Nature (London); 229: 388-91(5 Feb 1971).

The evidence for cosmological evolution in radio galaxies is now stronger, and the shortness of the time scale for this evolution (10^9 years) compared with the typical ages of galaxies poses a serious problem for the conventional view of galactic history. (auth) (UK)

24830 COSMOLOGY AND INFRARED ASTRONOMY: CLOSING THE GAP BETWEEN THEORY AND PRACTICE. Peebles, P. J. E. (Princeton Univ., N. J.). Comments Astrophys. Space Phys.; 3: 20-6(Jan-Feb 1971).

The two approaches to infrared astronomy have been the attempt to detect localized sources in the sky and to measure the absolute energy flux in a substantial solid angle. Only the latter approach is discussed here. The main questions considered are: (1) How has the cosmological model evolved with time? (2) How has the luminosity and spectrum of a "typical" galaxy varied with time? (3) What is the appropriate equivalent number density of galaxies in the present epoch of the Universe? (4) How has this number density varied with time? (W.D.M.)

24831 ABSORPTION OF GRAVITATIONAL ENERGY BY A VISCOUS COMPRESSIBLE FLUID. Esposito, F. Paul (Univ. of Chicago). Astrophys. J.: 165: 165-70(1 Apr 1971).

The equations that govern the response of a viscous, compressible fluid to an incident gravitational wave are derived in the linearized approximation to general relativity. For a fluid in static equilibrium, this response depends on inhomogeneities in the coefficient of shear viscosity and appears as a sound wave and as a shear wave which heats a surface layer. (auth)

24832 INSTABILITY AND WAVES DRIVEN BY RADIATION IN INTERSTELLAR SPACE AND IN COSMOLOGICAL MODELS. Field, George B. (Univ. of California, Berkeley). Astrophys. J.: 165: 29-40(1 Apr 1971).

The small-amplitude disturbances in an arbitrary mixture of radiation and gas–dust are studied. The results are valid for arbitrary radiation density, gas density, gas pressure, absorption coefficient, scattering coefficient, and wavelength of the disturbance. The dispersion relation in one equation contains both the radiation instability of Spitzer and the damped waves of Lifshitz and Silk. The instability occurs only if radiation pressure exceeds gas pressure and the wavelength exceeds a critical value. The maximum growth rate is reduced (by effects of finite optical depth) from the value calculated by Spitzer. The instability, which may occur near the Sun, compresses gas in the same way as gravitation, with an e-folding time of $\approx 10^8$ years. In the interior of the Galaxy the time may be only a few million years. Contrary to the suggestion of Gamow, in big-bang models the instability occurs with only a negligible growth rate, making it unimportant for cosmology. The proper frequency and damping rate of nearly adiabatic waves is included for both optically thin and optically thick disturbances. The results for optically thick waves agree with those of Peebles when the absorption is neglected, but contain a new damping term when absorption is present. This new damping term, however, is numerically unimportant for cosmology. (auth)

24833 COSMOLOGICAL FOUNDATIONS OF ENTROPY-FREE THERMODYNAMICS. Gal-or, Benjamin (Technion-Israel Inst. of Tech., Haifa). Nature (London) Phys. Sci.; 230: 12(1 Mar 1971).

It is shown how the expansion of the Universe can serve as a point of departure in laying a new basis for the second law of thermodynamics. A new, entropy-free thermodynamics can thus be constructed in which the second law is derived from the first law. The theory postulated suggests a possible explanation for the serious contradictions inherent to statistical formalism of entropy increase in large portions of the non-equilibrium expanding Universe. (UK)

24834 ANOMALOUS REDSHIFT REVIEWED. Lewis, B. M. Nature (London) Phys. Sci.; 230: 13-15(1 Mar 1971).

Since the existence of a substantial non-Doppler redshift as suggested by Arp (Nature, 225: 1033(1970)) would be of some importance, his tests were repeated using a larger sample of data. No confirmation of Arp's hypothesis was found. It is concluded that the excellent correlation of optical and 21-cm systematic velocities suggests that, if the Arp-type anomalous redshift exists, it must uniformly affect the whole galaxy. As it is difficult to conceive a physical mechanism being sufficiently widespread and locally unobservable, it is not surprising to find no confirmation of Arp's hypothesis in the group or pair data. The only viable hypothesis for anomalies among the systemic velocities of the ordinary galaxies is applicable only to those few dominant objects with large blue-shifted nuclear velocities. (UK)

Planetary Phenomena

Refer also to abstract 24958.

24835 HYDROGEN ISOTOPES AROUND THE PLANETS. Hunten, Donald M. (Kitt Peak National Observatory, Tucson, Ariz.). Comments Astrophys. Space Phys.; 3: 1-6(Jan-Feb 1971).

The terrestrial planets are observed to have a coronal glow of Lyman-α around them due to resonance scattering of solar radiation by H atoms. The planetary coronae resemble the solar corona in that they are not fully bound by the gravitational field, and there is a continuous loss by Jeans escape. This loss is treated in some detail. (W.D.M.)

24836 ISOTOPIC COMPOSITION OF XENON AND KRYPTON IN THE LUNAR SOIL AND IN THE SOLAR WIND. Podosek, F. A.; Huneke, J. C.; Burnett, D. S.; Wasserburg, G. J. (California Inst. of Tech., Pasadena). Earth Planet. Sci. Lett.; 10: 199-216(Jan 1971).

Xenon and Kr analyses of three lunar samples, the Murray meteorite, and Xe from the terrestrial atmosphere are presented. The isotopic compositions of surface-correlated (solar wind?) and lunar-soil-spallation xenon and krypton are derived from the lunar soil data alone. The lunar-soil-spallation Xe is similar to that in lunar rocks and meteorites, but the lunar soil spallation Kr has higher ($^{84}Kr/^{83}Kr$) and ($^{82}Kr/^{83}Kr$). No adequate explanation is available for this Kr spectrum, although independent evidence for such a component comes from stepwise heating data. The surface-correlated Xe(SUCOR) is distinct from both AVCC and terrestrial Xe. However, SUCOR Xe cannot be directly identified with the solar wind, but may contain an admixture of gases from the lunar atmosphere implanted on the grain surfaces by ion pumping processes. The general fractionation trend in SUCOR Xe relative to the atmosphere presumably reflects the solar-wind composition. SUCOR Kr appears to be totally ascribable to the solar wind. Solar wind and terrestrial Kr are related by fractionation, but opposite to that of Xe. (auth)

24837 LIMIT ON THE RADIATION EROSION IN LUNAR SURFACE MATERIAL. Seitz, M. G. (Washington Univ., St. Louis); Wittels, M. C. Earth Planet. Sci. Lett.; 10: 268-70 (Jan 1971).

Evidence from Apollo 11 and Apollo 12 lunar samples indicates that particle radiation is not important for the production of grains in the lunar soil greater than 22 microns in size even though sufficiently prolonged irradiations by protons, heavy ions, and electrons fracture minerals and glasses like those found on the lunar surface. (auth)

24838 MAJOR ELEMENT VARIATION AND POSSIBLE SOURCE MATERIALS OF APOLLO 12 CRYSTALLINE ROCKS. Kushiro, Ikuo; Haramura, Hiroshi (Tokyo Univ.). Science; 171: 1235-7(26 Mar 1971).

Nine different crystalline rocks of the Apollo 12 samples were analyzed with conventional chemical rock analysis methods. Five of the rocks have normative quartz, whereas the others have normative olivine and hypersthene. The rocks show a wide range in the ratio of iron to magnesium, and their compositions fall on relatively smooth curves in the oxide variation diagram. It is suggested that these rocks, with one exception, represent different parts of a differentiated magmatic body, in which magmatic differentiation by crystallization and settling of olivine was most effective. The source material of the original magma may be peridotite with or without minor amounts of plagioclase or spinel or garnet, with the presence or absence of these minerals dependent on the depth of magma generation. (auth)

Atomic and Molecular Physics

Refer also to abstract 23758.

Atomic, Electron, Ion, and Molecular Beams and Their Reactions

Refer also to abstracts 23931, 24261, and 24280.

24839 (RISO-239) COMMENTS ON THE SCATTERING OF CHARGED PARTICLES BY SINGLE CRYSTALS. I. THE GENERAL CASE. Newton, C. S.; Chadderton, L. T. (Danish Atomic Energy Commission, Risoe, Research Establishment). Feb 1971. 24p. Dep. NTIS (U. S. Sales Only).

The scattering of a beam of fast charged particles by a single-crystal lattice is discussed in detail, and a qualitative picture is drawn of the quantum–classical transition. (auth)

24840 (UCRL-20253) EXCITED STATE PRODUCTION IN THIN FOILS FOR NEUTRAL INJECTION IN CONTROLLED THERMONUCLEAR FUSION EXPERIMENTS. Bornstein, Isaac (California Univ., Berkeley. Lawrence Radiation Lab.). Jan 1971. Contract W-7405-eng-48. 109p. Dep. NTIS.

Thesis.

Thin foils have been suggested as a charge-exchange medium for neutral injection into controlled thermonuclear fusion devices. In the experiments described here, the excited-state fraction, neutral fraction, and negative beam fractions are measured for deuterons in the energy range $10 < E < 100$ keV for thin carbon foils and for carbon foils with freshly evaporated exit layers of carbon, magnesium, niobium, and gold. Foil lifetimes are also measured for 5-μg carbon foils. In addition, a review is made of the literature on foil stopping power and scattering from foils. Foils are shown to have higher excited-state yields at energies below 20 keV H^+ than gases or vapors. In particular, carbon foils have a higher excited-state yield than the other foils tested. 71 references. (auth)

24841 CRYSTALLOGRAPHIC ANISOTROPY OF THE REFLECTION OF ELECTRONS FROM A TUNGSTEN SINGLE CRYSTAL. Gomoyunova, M. V.; Aliev, B. Z. (Physical-Technical Inst., Leningrad). Sov. Phys.-Solid State (Engl. Transl.); 12: 1981-3(Feb 1971).

Translated from Fiz. Tverd. Tela; 12: 2472-5(Aug 1970).

The reflection coefficient η of electrons of 0.3 to 3 keV energy was measured for outgassed tungsten {100} and {110} faces at ~80 and 300°K. Curves of η as a function of primary-electron energy show two types of structure: (1) strong maxima and minima with half-widths of the order of keVs, and (2) maxima and minima of small amplitudes and half-widths of the order of 10 eV. The theoretical aspects and diffraction phenomena are discussed briefly. (D.L.C.)

24842 FINE STRUCTURE IN THE ANGULAR DISTRIBUTIONS FOUND DURING THE SPUTTERING OF SINGLE CRYSTALS. Dubinskii, V. E.; Lebedev, S. Ya. Sov. Phys.-Solid State (Engl. Transl.); 12: 1834-6(Feb 1971).

Translated from Fiz. Tverd. Tela; 12: 2295-9(Aug 1970).

The sputtering patterns found during the bombardment of Ge, InSb, Re, and Cu single crystals by 70-keV argon ions are shown. Fine structure was found in all these angular distributions. (auth)

24843 DEPENDENCE OF SPUTTERING ALONG CLOSEST-PACKED DIRECTIONS ON ANGLE OF INCIDENCE OF THE IONS. Bukhanov, V. M.; Odintsov, D. D.; Yurasova, V. E. (Moscow State Univ.). Sov. Phys.-Solid State (Engl. Transl.); 12: 1937-9(Feb 1971).

Translated from Fiz. Tverd. Tela; 12: 2425-7(Aug 1970).

It is shown that the sputtering intensity of the (100) face of a copper target for each of the four closest-packed ⟨110⟩ directions, as well as in the ⟨100⟩ direction, depends on the angle of incidence of the bombarding ions in qualitatively the same way in each case analogous to the nonmonotonic variation in the common sputtering coefficient $S(\alpha)$. The ratio of the sputtering intensities in two $S(\alpha)$ directions making different angles with the direction of incidence of the ions is also a nonmonotonic function of the angle of incidence; however, it also has special features not appearing in the case of $S(\alpha)$. An explanation of these observed characteristics is presented on the basis of a "transparency-model" calculation, allowing for the contribution of the second and subsequent ion–lattice-atom collisions to the sputtering. (auth)

24844 HIGH-ENERGY ION-IMPACT PHENOMENA. Kaminsky, M. (Argonne National Lab., Ill.). J. Vac. Sci. Technol.; 8: 14-15(Jan-Feb 1971).

From 17th National Meeting of the American Vacuum Society, Washington, D. C. See CONF-701011.

An abstract of an invited paper on primary and secondary processes involved in penetration of MeV ions through solids is presented. A figure is included, which shows the mean stopping power, the total secondary-electron yield, and the total sputtering yield when protons of energy 0.30 to 1.50 MeV penetrate through Cu monocrystals along different crystallographic planes. (A.G.W.)

24845 SPUTTERING COEFFICIENTS OF NIOBIUM. Summers, A. J.; Freeman, N. J.; Daly, N. R. (Atomic Weapons Research Establishment, Aldermaston, Eng.). pp 348-52 of Nuclear Fusion Reactors. London; Inst. of Civil Engineers (1970).

From International Conference on Nuclear Fusion Reactors, Culham, England. See CONF-690901.

Sputtering of the vacuum walls of a fusion reactor will not only lead to plasma contamination but, due to erosion of the surface, may be the limiting factor for the wall lifetime. For many reasons niobium has gained favor over molybdenum as a possible wall material. The value of S = 0.004 atoms per ion for 18.8-keV deuterium (D^+) ion sputtering of niobium was determined and can be used to estimate the erosion rate of the vacuum wall. Consideration of a 500-MW(t) fusion reactor of wall area 380 m^2 with uniform radial losses of 10^{23} particles per sec results in a particle flux of $2.6 \times 10^{16}/cm^2/sec$. If the higher sputtering values expected for tritium and helium are taken into account, the average value for the sputtering coefficient is approximately 0.008 atoms per ion. Using these figures, the estimated erosion rate is ~1.2 mm per year and the wall lifetime of the order of two years. (UK)

24846 SPUTTERING OF NIOBIUM BY D^+ AND He^+ IONS. Yonts, O. C. (Union Carbide Corp., Oak Ridge, Tenn.). pp 424-8 of Nuclear Fusion Reactors. London; Inst. of Civil Engineers (1970).

From International Conference on Nuclear Fusion Reactors, Culham, England. See CONF-690901.

The sputtering of niobium by D^+ and He^+ ions was measured at a temperature of 1100°C. The sputtering ratios of 0.0042 and 0.051, respectively, are very low. Some comparative data are given, and the lifetime of a niobium wall in a thermonuclear reactor is estimated. (auth) (UK)

24847 ATOMIC CHARGE STATE RATIOS OF ^6Li IONS FROM 5.8 TO 16.4 MeV. Stocker, H.; Berkowitz, E. H. (Univ. of Notre Dame, Ind.). Can. J. Phys.; 49: 480-2(15 Feb 1971).

The ratio, F_{2+}/F_{3+}, of equilibrium charge state fractions was measured for $^6Li^{2+,3+}$ ions in thin carbon foils and found to vary from 14% to 1% over the ion energy range from 5.87 to 16.45 MeV. The measured ratio varies inversely with the fifth power of the ion velocity. (auth) (Canada)

24848 INJECTION AND THERMALIZATION OF HOT ELECTRONS IN SOLID, LIQUID, AND GASEOUS HELIUM AT LOW TEMPERATURES. Onn, David G.; Silver, M. (Univ. of North Carolina, Chapel Hill). Phys. Rev., A; 3: 1773-9(May 1971).

Thin-film cold-cathode emitters were used to inject electrons into solid helium, liquid helium under pressure, and gaseous helium at 4.2 and 20°K. The cross section for the interaction of the injected quasi-free electrons with the helium was deduced by use of an appropriate model for the thermalization of the electrons, and sundry other parameters of the quasi-free state, such as its lifetime and the collision frequency of the electron therein, were deduced. The cross section derived is within a factor of 2 of the value for the elastic scattering cross section for the isolated atom. The description of the scattering and thermalization process is dependent only on the helium atomic density and is independent of phase. (auth)

24849 SECONDARY EMISSION OF Mo^+ IONS UPON BOMBARDMENT OF MOLYBDENUM BY Rb^+ AND Na^+ IONS. Adylov, A. A.; Veksler, V. I.; Reznik, A. M. (Tashkent Univ.). Dokl. Akad. Nauk Uzb. SSR; No. 11, 20-2(1969). (In Russian).

The time dependence of the yield and the energy spectra of Mo^+ ions produced by bombardment of Mo by Na^+ and Rb^+ ions were measured. Comparison of the results with results of similar measurements made previously for Cs^+ and K^+ ions indicates that the half-width of the spectra decreases somewhat with decreasing mass of the bombarding ion. (A.G.W.)

24850 K_α/K_β X-RAY INTENSITY RATIOS FROM ELECTRON BOMBARDMENT. Mistry, V. D.; Quarles, C. A. (Texas Christian Univ., Fort Worth). Nucl. Phys.; A164: 219-24(1971).

The K_α/K_β x-ray intensity ratios were measured for Cu, Zn, Ag, Sn, Dy, and Au using a Ge(Li) x-ray detector. The K-shell vacancy was produced by bombarding targets fabricated from pure elements or their compounds with an electron beam whose energy could be varied from 40 to 140 keV. The results are compared with other recent experiments and with the theoretical calculations of Scofield. (auth)

24851 SECONDARY EMISSION IN WATER PRODUCED BY ELECTRON BOMBARDMENT. Lemperiere, G. (Univ., Nantes, France). J. Phys. (Paris); 31: 1033-9(Nov-Dec 1970). (In French).

Secondary emission from liquid water under reduced pressure, bombarded with an electron beam of energy between 3 and 10 keV, was studied. A method of determining Δ, the coefficient of secondary emission for water, was derived from theoretical expressions obtained for the currents collected. The variation of Δ with the energies of the primary electrons is similar to that observed for secondary emission from metals in the same energy range. (auth) (France)

24852 CuD IN BURNOUT V. McNally, J. R. Jr.; Neidigh, R. V. (Oak Ridge National Lab., Tenn.). J. Quant. Spectrosc. Radiative Transfer; 11: 125-7(Jan 1971).

The neutral diatomic molecule, CuD, with rotational excitation temperature of 0.23 eV, was positively identified in the Burnout V apparatus. The molecule CD was also observed by replacing portions of the copper, Burnout V liner material with carbon. The dependence of the molecular spectral radiance on combinations of carbon, copper and niobium, a material of minimal sputtering characteristics, and their location in the liner, lead one to believe that the molecules are produced by energetic Cu and C (≤3 keV) bombardment of deuterium occluded in the liner material. (auth) (UK)

24853 MOLECULAR AND ATOMIC IONS OF THE ELEMENTS OF THE SUBGROUPS A OF THE PERIODIC SYSTEM. Kaiser, H. J.; Heinicke, E.; Baumann, H.; Bethge, K. (Univ., Heidelberg). Z. Phys.; 243: 46-59(1971).

The production of positive and negative ions of all elements of the subgroups A and some of the subgroups B was investigated as an extension of previous work on Penning sources. Molecular ions of the type $X_n^{\pm}$, n > 1, and ions of hydride molecules $X_nH_m^{\pm}$, n, m > 1, were found. The maximum number m_{max} of the H atoms bound in the cluster is determined by the position of the element in the periodic system. The yield of the atomic and molecular beams was measured as a function of the electric source parameters and the different gases maintaining the discharge to establish the production mechanism. The data on ion-beam intensities and the state of clustering of molecules are listed in tables. (auth)

24854 Z_1 DEPENDENCE OF K-SHELL X-RAY PRODUCTION BY HEAVY CHARGED PARTICLES. Basbas, G.; Brandt, W.; Laubert, R. (New York Univ., N. Y.). Phys. Lett.; 34A: 277-8 (22 Mar 1971).

New measurements on Al at 0.1 to 0.9 MeV/amu give K-shell ionization cross-section ratios $\sigma(He)/4\sigma(H) > 1$, contrary to the plane-wave Born approximation prediction of unity. The effect is similar to the Z_1^3 effect found in stopping powers and may be caused by the same atomic processes. (auth)

24855 EFFECTS OF SURFACE DISORDER, VARIOUS SURFACE STRUCTURES OF CHEMISORBED GASES AND CARBON ON HELIUM ATOMIC BEAM SCATTERING FROM THE (100) SURFACE OF PLATINUM. West, L. A.; Somorjai, G. A. (Univ. of California, Berkeley). J. Chem. Phys.; 54: 2864-73(1 Apr 1971).

Low-energy electron diffraction and helium atomic-beam scattering were combined to investigate, on the (100) face of a platinum single crystal, the effects of changing surface structure on the gas–solid interaction. The angular distribution of a helium beam scattered from the ordered and disordered crystal face was monitored. The intensity of the beam scattered at the specular angle increases by nearly an order of magnitude upon atomic ordering of the metal surface. Ordered domains of graphitic carbon also yielded high-intensity peaks in the specular direction. The magnitude of the intensity maxima for helium beams scattered from ordered surface structures of various chemisorbed gases (CO, C_2H_2) was sensitive to surface order but insensitive to the type of surface structure formed. For all the surface structures studied the scattered helium beam distribution was directed with the intensity maximum at the specular angle. The surface-temperature dependence of the beam dispersion and intensity scattered at the specular angle was monitored in the temperature range 450 to 1300°K. Anomalous changes in the beam intensity could be associated with the adsorption of carbon monoxide on the crystal face. (auth)

24856 SURFACE AND VACUUM PHYSICS INDEX. VOLUME 6, NO. 1, 1971. Bibliography, Author Index, Subject Index in Alphabetical Order, Cumulative Subject Index in Logical Order. Frankfurt am Main: Zentralstelle fuer Atomkernenergie-Dokumentation (1971). 72p.

This listing includes 260 references on various aspects of surface and vacuum physics. (A.G.W.)

Atomic and Molecular Properties

Refer also to abstracts 24160, 24740, 24806, and 24807.

24857 (SC-RR-710075) L-SHELL AUGER, COSTER–KRONIG AND RADIATIVE MATRIX ELEMENTS, AND AUGER AND COSTER–KRONIG TRANSITION RATES IN j–j COUPLING. McGuire, Eugene J. (Sandia Labs., Albuquerque, N. Mex.). Mar 1971. 64p. Dep. NTIS.

All the matrix elements used to compute L-shell fluorescence yields are tabulated. Also included are the transition rates in j–j coupling. (auth)

24858 (UCRL-20142) RADIATIVE LIFETIME OF THE 2^1S_0 METASTABLE STATE OF HELIUM. Van Dyck, Robert Spaulding Jr. (California Univ., Berkeley. Lawrence Radiation Lab.). 20 Nov 1970. Contract W-7405-eng-48. 167p. Dep. NTIS. Thesis.

A time-of-flight technique was used to measure the radiative lifetime of the 2^1S_0 state of helium. After passing from a cooled source, helium atoms are excited to the 2^1S_0 state by a pulsed electron gun. The atomic beam then contains primarily ground-state helium atoms and metastable atoms in both the 2^3S_1 and the 2^1S_0 excited states. The time-of-flight spectrum for the metastable 2^3S_0 state can be separated from the 2^3S_1 state by using an rf-discharge helium lamp: The 2^1S_0 state is quenched by absorption of a 20,518-Å photon, raising the atom to the 2^1P_1 state, which then decays preferentially to the $^1S_0$ ground state; the 2^3S_1 state remains unaffected because it is the ground state for the triplet system. The time-of-flight spectrum for the 2^1S_0 atoms is therefore obtained from the difference between the full beam and the quenched beam. The metastable atoms are then detected at two positions (d_1 = 1.9 m and d_2 = 6.7 m from the electron gun) by Auger ejection of an electron from a copper target, the first of which is a 60% transmitting mesh. Neutral helium atoms cannot cause an electron to be ejected and are not detected. A comparison of the number of metastables within a given velocity interval at the two detectors determines the number that decay in flight and yields a value for the two-photon radiative lifetime τ. The final value for the singlet lifetime is 20.2 ± 1.0 msec. The 1.0-msec error is one standard deviation, determined primarily from the uncertainty arising from the sensitivity of the analysis program to small errors in d_1 and d_2, and includes an estimate of the remaining systematic error in the experiment. (auth)

24859 UNIFIED THEORY CALCULATIONS OF STARK-BROADENED HYDROGEN LINES INCLUDING LOWER-STATE INTERACTIONS. Vidal, C. R.; Cooper, J.; Smith, E. W. (National Bureau of Standards, Boulder, Colo.). J. Quant. Spectrosc. Radiative Transfer; 11: 263-81(Mar 1971).

Recently published calculations of hydrogen Stark broadening on the basis of the unified classical path theory were extended to include lower-state interactions in the final line profile. A detailed comparison with experiments in the density range 10^{13} to 10^{17} cm^{-3} is given. (auth) (UK)

24860 TRANSITION FROM AMBIPOLAR TO FREE DIFFUSION OF IONS. Gerber, R. A.; Gusinow, M. A.; Gerardo, J. B. (Sandia Labs., Albuquerque, N. Mex.). Phys. Rev., A; 3: 1703-7 (May 1971).

The transition from ambipolar to free diffusion for He_2^+ in a helium afterflow was observed with a mass spectrometer. The theory of Allis and Rose predicts the general features of the observed behavior. (auth)

24861 HIGH-Z L-SUBSHELL X-RAY EMISSION RATES. Rao, P. Venugopala; Palms, J. M.; Wood, R. E. (Emory Univ., Atlanta). Phys. Rev., A; 3: 1568-75(May 1971).

Relative intensities of L x rays emitted during the radiative decay of L_2 and L_3 subshell vacancies are investigated by Si(Li) x-ray detectors, over a range of $65 \leq Z \leq 94$. Intensities of transitions involving N, O, ... electrons compared to those involving M-shell electrons are found to be slightly underestimated in Scofield's theoretical calculations. L_1 subshell yields for Z = 82 are measured by a high-resolution study of the Pb L-x-ray spectrum from the decay of ^{207}Bi with the following results: ω_1 = 0.09 ± 0.02, f_{12} = 0.17 ± 0.05, f_{13} = 0.61 ± 0.08, and s_1 = 0.353 ± 0.053. (auth)

24862 EFFECT OF TIME ORDERING IN THE UNIFIED THEORY. Godfrey, J. T.; Vidal, C. R.; Smith, E. W.; Cooper, J. (National Bureau of Standards, Boulder, Colo.). Phys. Rev., A; 3: 1543-6(May 1971).

Using a previously developed unified theory of spectral line broadening, the effects of time ordering over the complete line profile are investigated. The results of calculations for the Lyman–α line are presented. (auth)

24863 THEORETICAL DERIVATION OF THE ABSOLUTE LINE STRENGTHS OF Tm I. Camus, P. (CNRS, Orsay, France). J. Phys. (Paris); 31: 985-92(Nov-Dec 1970). (In French).

The absolute line strengths associated with transitions between the ground multiplet ^2F of $4f^{13}$ 6 S^2, and the levels belonging to the even $4f^{13}$ 6s 6p and $4f^{12}$ 5d $6s^2$ configurations were calculated using eigenvectors obtained from the intermediate coupling scheme by Racah's empirical method and the dipole integrals computed from Hartree–Fock solutions. The predicted values of the absorption oscillator strengths and the lifetime of the levels are compared with experimental determinations. (auth) (France)

24864 IMPROVED EXPERIMENTAL VALUES FOR SOME HYDROGEN-LIKE LEVELS OF He I. Litzen, Ulf (Lund Univ., Sweden). Phys. Scr.; 2: 103-5(1970).

The 3d–nf (n = 4, 5, 6) and 4f–5g transitions in He I, appearing in the extraphotographic infrared, were measured with a wavenumber accuracy better than 0.01 cm^{-1}. Improved level values were derived for the 4f, 5f, 6f, and 5g terms. The experimental values are compared with values calculated from the polarization formula. (auth) (Sweden)

24865 DESIGN AND CONSTRUCTION OF A SYSTEM FOR DIRECT MEASUREMENT OF ATOMIC LIFETIMES. Blanc, Theodore V.; Danemar, Ake G.; Koltenbah, David E. (Ball State Univ., Muncie, Ind.). Proc. Indiana Acad. Sci.; 78: 389-93(1968).

The project reported involved the design and construction of a system to directly measure atomic lifetimes. The system follows the technique employed by Jules Klose of the National Bureau of Standards. A low-energy 10- to 30-eV 200-nsec-duration 10-kHz square-wave electron excitation pulse was used to excite a gas at a pressure of 1×10^{-4} torr. The visible emission spectrum was observed by a photomultiplier through a grating spectrometer, which permitted the selection of the desired spectral line or energy-level transition. Employing delayed coincidence techniques familiar in nuclear physics, the square excitation pulse and the ensuing photomultiplier pulse were fed into a time-to-pulse-height converter and pulse-height analyzer whose output would display the decay of the emission intensity as a function of the time for relaxation of the atomic systems. The project was completed to the construction of the time-to-pulse-height converter and promises to be useful in obtaining data on atomic lifetimes. (auth)

24866 TABLITSY ATOMNYKH VOLNOVYKH FUNKTSII. (Tables of Atomic Wave Functions). Brattsev, V. F. Leningrad: Izdatel'stvo Nauka Leningradskoe Otdelenie (1970). 456p.

Radial wave functions of excited states of light atoms from helium to neon inclusive are tabulated. The wave functions were obtained by numerical solution of the Hartree–Fock equations within the limits of a single-configuration approximation. The tables are a continuation of the book, Tables of Atomic Wave Functions, published in 1966. (R.V.J.)

24867 VARIATIONAL COMPUTATION OF THE POLARIZABILITY OF THE HELIUM ATOM. Weislinger, Edmond; Caire, Jean-Pierre (Univ., Nancy). Compt. Rend., Ser. B; 272: 353-4 (8 Feb 1971). (In French).

The polarizability of helium is determined by a method due to J. Barriol and J. Régnier (Compt. Rend., 237: 307(1953)) using a double zeta function for the single-electron orbital of the ground state. (auth) (France)

24868 EFFECTS OF ADDITIONS ON THE He_2 AFTERGLOW IN HELIUM EXCITED BY AN INTENSE PULSE OF ELECTRONS. Bourene, M.; Le Calve, J. (CEA, Saclay, France). J. Phys. (Paris); 32: 29-33(Jan 1971). (In French).

The excitation of helium at pressures between 50 and 1500 torr by a short electron pulse leads to afterglow emissions due to transitions between excited states of the He_2 molecule. The oscillograms obtained for the 6400-Å He_2 ($d^3\Sigma_u^+ \rightarrow b^3\pi_g$) emission at different helium pressures are discussed. The termination of the afterglow appears to be controlled by the neutralization kinetics of the He_2^+ ions. Measured rate constants for the He_2^+ reactions with O_2, H_2,

XUM

N_2, CO, CO_2, N_2O, H_2O, NH_3, CH_4, Ne, Ar, Kr, and Xe are given. (auth) (France)

24869 COLLISION PHYSICS AND IONIZED GASES. Bull. Inform. Sci. Tech. (Paris): No. 152, 3-17(Oct 1970). (In French).

Theoretical and experimental studies made on ionized Cs vapor are described; these studies were made in order to determine the macroscopic characteristics in the stationary and relaxation regions. These investigations were undertaken to simulate the behavior of an ionized vapor from fundamental data on the interaction between particles. The determination of the ion–electron recombination coefficient of He_2^+ at 300°K in the afterglow of a helium discharge is discussed. It is shown how, in a neutral gas, photoexcitation techniques may be used to study atom–atom collisions. (auth) (France)

24870 THERMOLUMINESCENCE OF THORIUM OXIDE SINGLE CRYSTALS. Rodine, Elward Theodore. Lincoln, Nebr.; Univ. of Nebraska (1970). 140p. University Microfilms Order No. 71-3654.

Thesis.

Results are presented of measurements of the thermoluminescence between liquid nitrogen temperature and 300°C of a large number of ThO_2 single crystals. These results indicate that the same traps occur commonly in crystals grown by different methods and that differ considerably in purity, although there are substantial differences in apparent trapping densities. The most important glow peaks have maxima at about −160°C, −120° to −100°C, −14°C, and 150°C. The maxima of the thermoluminescence excitation spectra and the ultraviolet cutoff are shown to coincide, indicating that some trap excitation involves a band-gap transition and that the band gap is 5.75 eV. The thermoluminescence emission spectra observed in this investigation are quite broad in some cases, but in other cases they are the sharp line spectra of particular rare earths. The fluorescence emission for some of these ThO_2 crystals appears to be identical to the thermoluminescent emission. Dosage studies on these crystals indicate relative trap densities and show cases of linear and quadratic growth of thermoluminescence with dose. Excitation due to the radioactivity of thorium is observed in some of these crystals. Energy and frequency factor analysis of the trapping states is performed, and comparison is made between the results obtained by applying the methods of initial rise, inflection points, and halfwidths according to monomolecular and bimolecular models. The thermoluminescence experiments discussed are correlated with each other and with EPR measurements. This investigation shows that as few as 10^{10} optical transitions are necessary for a resolvable glow peak and that concentrations of rare earth impurities of less than 1 ppM may result in bright thermoluminescence. No correlation between the thermoluminescent trapping states and specific impurities was determined. There are strong indications that the trapping states are due to intrinsic defects involving oxygen vacancies, and several models are proposed and correlated with the experimental results. (Diss. Abstr. Int., B)

24871 APPROXIMATE SINGLE-CENTER PERTURBATION CALCULATIONS. I. GROUND STATES OF H_2^+, HeH^{2+}, H_2, HeH^+, He_2^{2+}, AND LINEAR SYMMETRIC H_3^+. Mackrodt, W. C. (Faculte des Sciences, Orsay, France). J. Chem. Phys.; 54: 2952-61(1 Apr 1971).

Using the "molecular puff" equations as a starting point, first-order perturbation equations are solved for H_2, HeH^+, He_2^+, and linear symmetric H_3^+, and first- and second-order equations for H_2^+ and HeH^{2+}. The perturbation wave functions are expanded in partial waves, and the resulting equations are solved by numerical integration for the $1s\sigma$ ground states. The errors in the calculated energies are in the range 0.5 to 10.0 kcal/mol and represent a considerable improvement on similiar calculations reported by Hauck, Kim, Parr, and Hameka [J. Chem. Phys., 47: 2677 (1967)]. (auth)

24872 PHOTOIONIZATION OF EUROPIUM AND THULIUM: THRESHOLD TO 1350 A. Parr, Albert C. (Univ. of Chicago). J. Chem. Phys.; 54: 3161-7(1 Apr 1971).

Photoionization spectra of europium and thulium are reported from threshold to 1350 Å. The ionization efficiency in this region is found to be dominated by autoionization. Autoionization structure, believed to be due to $4f^N6s^2 \rightarrow 4f^N5dnp$ transitions, is interpreted and other strong resonances are listed. The ionization potential of europium is determined to be 5.664 ± 0.008 eV and that of thulium to be 6.180 + 0.008 eV. (auth)

24873 COUPLING SCHEMES IN THE $4f^7(^8S)$ nln'l' CONFIGURATIONS OF Eu I AND Gd II. Goldschmidt, Z. B.; Nir, S. (Hebrew Univ., Jerusalem). Physica; 51: 222-8(29 Jan 1971).

The strengths of the various interactions in the $4f^7(^8S)$ nln'l' configurations of Eu I and Gd II are defined and calculated. They are then used to determine for each of these configurations the coupling scheme closest to the physical coupling. In all cases, the coupling schemes thus determined are confirmed through the comparison of the composition percentages of the eigenvectors in the various possible coupling schemes. It is shown that configuration interaction also affects the couplings within the configurations. (auth)

24874 ELECTROSTATIC AND SPIN-ORBIT INTERACTIONS IN FOUR-PARTICLE SYSTEMS. Nir, S. (Hebrew Univ., Jerusalem). Physica; 51: 229-39(29 Jan 1971).

Closed formulas for the electrostatic and spin–orbit interactions for four-particle systems are derived. Two types of systems are treated: (1) four electrons and (2) three electrons and a single hole in a filled shell. The electrostatic interaction between configurations of two electrons outside a closed shell and configurations of three electrons and a hole is also calculated. The formulas are written in a form amenable to electronic computer calculations. The results are applicable to the construction of energy matrices for neutral atoms at the ends of the rare-earth, platinum, and actinide groups. (auth)

24875 DETERMINATION OF OPTICAL CONSTANTS OF Gd AND Dy DURING ENERGY-LOSS MEASUREMENTS OF 60-keV ELECTRONS. Daniels, J. (Univ., Hamburg). Opt. Commun.; 3: 13-16(Mar 1971). (In German).

The energy losses of 60-keV electrons in gadolinium and dysprosium were investigated in order to calculate the energy-loss function Im $(-1/\epsilon)$ and the optical constants ϵ_1 and ϵ_2 in a large region of energy. The ϵ_2 spectra at lower energies can be explained by band-structure calculations. Excitations at higher energies, due to transitions from deeper shells, are found at nearly the same positions as in the case of x-ray absorption. (auth)

24876 STARK BROADENING OF Ly-α BY STRONG ELECTRON COLLISIONS. Pfennig, H. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Phys. Lett.; 34A: 292-4 (22 Mar 1971).

In the Stark broadening of Ly-α it is important to consider strong collisions, but the way of doing this is of minor importance. In the dipole-only case it is possible to express the matrix elements of the time-evolution operator in terms of elementary functions. (auth)

Positronium, Muonium, and Mesic Atoms and Molecules

Refer also to abstract 25641.

24877 POSITRON LIFETIME STUDIES IN ORGANIC MEDIA. Singh, K. P.; Singru, R. M.; Rao, C. N. R. (Indian Inst. of Tech., Kanpur). J. Phys., B (London); 4: 261-8(Feb 1971).

Lifetimes of positrons annihilating in a number of organic compounds consisting of aromatic hydrocarbons, substituted benzenes, phenols, anilines, and ketones were measured. Experimentally measured values of τ_2 and I_2 were examined to determine whether positron annihilation takes place at a particular site of the molecule or whether it depends on average properties of the molecules. The intensity I_2 seems to be related to the width or Ore gap in organic molecules; the τ_2 values in molecular liquids, however, can be interpreted in terms of additive atomic contributions to pick-off quenching. In substituted benzenes the results show changes due to substituent effects; these changes could be correlated with Hammett's σ-constant. Results indicate that positron annihilation in organic media is determined by microscopic properties of the molecules such as ionization potentials (or width of Ore gap) and electron densities at the annihilation sites. (auth) (UK)

Collision Phenomena

24878 (JINR-P4-5608) SLOW COLLISIONS IN THE SYSTEM OF THREE BODIES INTERACTING ACCORDING TO THE COULOMB LAW. Matveenko, A. V.; Ponomarev, L. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1971. 27p. (In Russian). Dep. NTIS (U. S. Sales Only).

A general approach to the solution of the problem of slow collisions in a system of three bodies interacting according to the Coulomb law is formulated. The perturbed stationary state method,

i.e., expansion of the solutions of the Schroedinger equation for the three-body problem according to eigenfunctions of the two-center problem in quantum mechanics, is used. The technique described makes possible the formulation and solution of a number of the problems of atomic and mesoatomic physics. Particular cases of such problems were solved by the authors in previous papers. (auth)

24879 (SC-RR-710050) ENERGY AND ANGULAR DISTRIBUTIONS OF ELECTRONS EJECTED FROM N_2 BY ELECTRON IMPACT. Tisone, G. C. (Sandia Labs., Albuquerque, N. Mex.). Mar 1971. 41p. Dep. NTIS.

Energy and angular distributions of electrons ejected from N_2 after ionization by electrons with energies of 500, 750, and 1000 eV were measured using crossed molecular and electron beams. The ejected-electron spectra at selected angles were measured for ejected energies up to 500 eV with an energy resolution of $\Delta E = 0.015$ E at fwhm. The energy spectra were measured between 40° and 115° where a maximum in the number of ejected particles occurs. Measurements were made at 5° intervals with an angular resolution of 2°. Absolute cross sections, differential in energy and angle, were obtained by normalization to absolute elastic scattering cross sections. Estimates of the K-shell ionization cross section for 750-eV and 1000-eV incident electrons were obtained. (auth)

24880 RADIATIVE ELECTRON–ION RECOMBINATION INTO THE FIRST EXCITED STATE OF LITHIUM. Rothe, Dietmar E. (Cornell Aeronautical Lab., Inc., Buffalo). J. Quant. Spectrosc. Radiative Transfer; 11: 355-65(Apr 1971).

The emission continuum resulting from electron–ion recombination into the $2p^2P_{1/2}$ state of lithium was investigated. The radiation source was a lithium-seeded argon plasma created behind the reflected shock in a pressure-driven shock tube. Absolute intensity measurements were used to deduce photoionization cross sections for the 2P state of lithium for photons having wave- at the threshold wavelength (3500 Å) was measured to be 19.7 Mb and was found to diminish with decreasing wavelength at a rate approximately proportional to the square of the wavelength. (auth) (UK)

24881 COULOMB–BORN EXCITATION CROSS SECTIONS OF HYDROGEN-LIKE IONS BY ELECTRON IMPACT AT THRESHOLD. Jacobs, A. (Space Research Lab., Utrecht). J. Quant. Spectrosc. Radiative Transfer; 11: 143-52(Feb 1971).

A method is described for the computation of excitation cross sections of hydrogen-like ions in the Coulomb–Born approximation. The radial integrals occurring in the coupled angular momentum representation were expanded in a singly infinite series with real terms. These series are convergent near threshold. Exchange contributions were discussed. (auth) (UK)

24882 ELECTRON IMPACT EXCITATION RATE COEFFICIENTS FOR HYDROGEN, HELIUM, AND ALKALI ATOMS. Park, C. (Ames Research Center, Moffett Field, Calif.). J. Quant. Spectrosc. Radiative Transfer; 11: 7-36(Jan 1971).

The rates of electron-impact excitation of bound electronic states are calculated by interpolating the existing quantum-mechanical theories and applying an empirical correction. The calculation is done for hydrogen, helium, lithium, sodium, potassium, rubidium, and cesium. The resulting rate coefficients are expressed by two parameters, the values of which are presented in tables. The error of the present calculation is estimated by comparing with available experimental data to be within a factor of approximately 2. (auth) (UK)

24883 ELECTRON DETACHMENT IN OXYGEN. Eccles, M. J.; O'Neill, B. C.; Craggs, J. D. (Univ. of Liverpool). J. Phys., B (London); 3: 1724-31(Dec 1970).

Using a double ionization chamber in one half of which negative ions are formed and in the other half of which they suffer detachment, experiments on the collisional detachment from O_3^- and O_2^- in oxygen, at E/p at 20°C equal to 45 to 50 V cm^{-1} $torr^{-1}$, give values for the detachment coefficient per unit pressure $\delta/p \sim 0.01$. Pressure variations (20 to 60 torr) are discussed. For Townsend discharges in these circumstances in oxygen, detachment is thus relatively unimportant in that $\delta \ll \eta$ (the attachment coefficient). (auth) (UK)

24884 SURVEY OF RESONANT EFFECTS IN THE LIGHT EMITTED BY A DIATOMIC MOLECULAR GAS EXCITED BY ELECTRON BOMBARDMENT. Nedelec, O.; Baltayan, P. (Faculte des Sciences, Grenoble, France). J. Phys., B (London); 3: 1646-56(Dec 1970).

It was recently found that when a molecular gas is excited by electronic bombardment the subsequently emitted light is polarized. The possibility of studying molecular states excited by this technique in the presence of magnetic and/or electric fields is studied. The measurements are made on the polarization of the light emitted from a level for which the total angular momentum is known. The theory of irreducible tensor operators previously applied to such experiments in atoms is extended to diatomic molecules. All resonant effects observed in atoms may be expected in molecules. When an electric field is added, new effects may arise in polar molecules and make it possible to measure the permanent electric dipole moment and the Λ doubling in some cases. (auth) (UK)

24885 CLASSICAL THEORY OF EXCITATION, DE-EXCITATION, AND IONIZATION OF ATOMS BY CHARGED PARTICLES. Flannery, M. R. (Harvard Coll. Observatory, Cambridge, Mass. Smithsonian Astrophysical Observatory, Cambridge, Mass.). J. Phys., B (London); 3: 1610-19(Dec 1970).

A classical treatment of inelastic collisions between neutral atoms and charged particles is presented. Detailed balance between the rates for the forward and reverse transitions is satisfied. The theory is used to calculate the cross sections for ionization of atomic hydrogen by electron and proton impact and for the excitation by electrons of various levels of hydrogen. Comparison of the results with the Born cross sections and experimental data shows that the theoretical description is fairly successful for inelastic transitions to the continuum or to a discrete level sufficiently close to the continuum. (auth) (UK)

24886 IMPACT-PARAMETER TREATMENT OF HYDROGEN–HYDROGEN EXCITATION COLLISIONS. III. ELECTRON EXCHANGE AND NUCLEAR SYMMETRY EFFECTS. Bottcher, C.; Flannery, M. R. (Harvard Coll. Observatory, Cambridge, Mass. Smithsonian Astrophysical Observatory, Cambridge, Mass.). J. Phys., B (London); 3: 1600-9(Dec 1970).

By using a basis set of symmetrized atomic orbitals, the influence of electron exchange and nuclear symmetry is examined for the 2s and 2p collisional excitations of hydrogen by a hydrogen atom with impact energy E in the range $0.25 \leq E \leq 225$ keV. These effects reduce all the cross sections and affect the 2s excitation more than the 2p excitation. At high energies, the results tend to the Born values, indicating that the neglect, in this treatment, of the phase factors that account for the translational motion of the atomic electrons does not cause much error for excitation. (auth) (UK)

24887 ELECTRONIC IONIZATION AND RECOMBINATION COEFFICIENTS FOR ATMOSPHERIC MOLECULES. I. ELECTRON IMPACT IONIZATION CROSS-SECTIONS. Sharma, V. N.; Tripathi, D. N.; Rai, D. K. (Banaras Hindu Univ., India). J. Quant. Spectrosc. Radiative Transfer; 11: 283-9(Mar 1971).

The electron-impact ionization cross sections for some molecular atmospheric species such as N_2, O_2, H_2, NO, CO, and CO_2 were calculated using different classical and semiempirical formulae. The effect of nuclear motion was included as suggested by Bauer. It is found that the semiempirical formula of Drawin with modified values of the parameters f_1 and f_2 reproduces the experimental values satisfactorily. Cross sections calculated by using this Drawin formula were used for the calculation of the ionization and recombination coefficients for an O_2 plasma. (auth) (UK)

24888 SIMPLIFIED MODEL FOR POSITRONIUM–HELIUM SCATTERING. Drachman, R. J.; Houston, S. K. (Goddard Space Flight Center, Greenbelt, Md.). J. Phys., B (London); 3: 1657-62(Dec 1970).

Using a local effective potential to account for electron exchange, the zero-energy scattering of ortho-positronium by helium atoms was analysed. The effective potential was chosen so that the results obtained in the static approximation agreed with the static-exchange results of Fraser and Kraidy. Correlation was introduced in two different approximations that agree well. A decrease in the scattering length a from 1.72 to 1.39 a_0 and an increase of more than a factor of 2 in the quenching rate of the positronium (from $Z_{eff} = 0.042$ to 0.10) as compared with the static-exchange approximation were found. This gives improved agreement with the experimental value $Z_{eff} \simeq 0.18$. (auth) (UK)

24889 MEASUREMENTS OF INELASTIC ENERGY LOSS IN ATOMIC COLLISIONS OF Al^+, P^+, S^+, Cl^+, Ar^+, K^+, AND Mn^+ ON ARGON AT keV ENERGIES AND LARGE SCATTERING ANGLES. Fastrup, B.; Hermann, G.; Smith, K. J. (Univ. of Aarhus, Denmark). Phys. Rev., A; 3: 1591-1606(May 1971).

The inelastic energy-loss distribution Q was measured for single large-angle collisions between argon atoms and incident projectile ions with atomic numbers Z_1 ranging from 13 to 25. The data are

obtained by measuring the energy and scattering angle of the scattered incident particle. This method provides well-resolved Q spectra, being almost undisturbed by thermal target motion. In all cases studied, the Q value exhibits a sudden change and a triple-peaked structure in a narrow range of distance of closest approach γ_0. The location of the three peaks Q_I, Q_{II}, and Q_{III} varies with γ_0, but their energy separations remain independent of γ_0. For the heteronuclear collisions reported here, the values of the Q-peak separations suggest that Q_{II} and Q_{III} correspond to the production of one and two $L_{2,3}$ vacancies, respectively, in one of the colliding particles, viz., the one with the lower atomic number. This is further supported by studies of Auger electrons emitted in the collisions (auth)

24890 COLLISION SPECTROSCOPY. IV. SEMICLASSICAL THEORY OF INELASTIC SCATTERING WITH APPLICATIONS TO $He^+ + Ne$. Olson, R. E.; Smith, F. T. (Stanford Research Inst., Menlo Park, Calif.). Phys. Rev., A; 3: 1607-17(May 1971).

A two-state semiclassical theory of elastic and inelastic scattering is formulated and compared to the Stueckelberg–Landau–Zener, distorted-wave, and close-coupled two-state methods. The semiclassical theory is shown to explain the physical origin of oscillatory structure on both the elastic and inelastic differential cross sections and of a rainbow-like structure in the elastic scattering. Using simple and plausible interactions, theoretical elastic and inelastic differential cross sections are calculated and compared to the experimental measurements of the elastic and inelastic differential cross sections for $He^+ + Ne$. The scattering is characterized by a $^2\Sigma - ^2\Sigma$ crossing located at $\gamma_x = 2.02$ a.u. with an energy $E_x = 0.530$ a.u., leading to the final state $He^+ + He^*$ ($2p^5\ 3s$). The interaction energy at the crossing is found to be $V_{12}(\gamma_x) = 0.0082$ a.u. (auth)

24891 MEASUREMENTS OF THE TOTAL CROSS SECTION FOR THE SCATTERING OF LOW-ENERGY ELECTRONS BY METASTABLE ARGON. Celotta, Robert; Brown, Howard; Molof, Robert; Bederson, Benjamin (New York Univ., N. Y.). Phys. Rev., A; 3: 1622-8(May 1971).

Measurements are presented of the total cross section for scattering of low-energy electrons by a mixture of $^3P_0$ and $^3P_2$ metastable argon. The atomic beam-recoil method was used to make an absolute measurement. The cross section was measured from 0.35 to 6.75 eV with an angular resolution of 16.1° in the electron polar scattering angle at an electron energy of 1 eV. The velocity distribution of the atomic beam was measured by time-of-flight spectroscopy. Electron beams with typical energy distributions of 0.3 eV fwhm were used. The overall error in the cross section is estimated at ±13% and the electron-energy determination is believed accurate to ±0.150 eV. (auth)

24892 ANGULAR AND ENERGY DISTRIBUTION OF CROSS SECTIONS FOR ELECTRON PRODUCTION BY 50- TO 300-keV PROTON IMPACTS ON N_2, O_2, Ne, AND Ar. Crooks, J. B.; Rudd, M. E. (Univ. of Nebraska, Lincoln). Phys. Rev., A; 3: 1628-34 (May 1971).

Cross sections differential in angle and ejection energy for electron production by proton impact on nitrogen, oxygen, neon, and argon were measured using electrostatic analysis and counting of individual electrons. The range of proton energies was 50 to 300 keV, the angles ranged from 10° to 160°, and the electron energies were measured from 1.5 to 1057 eV. Integrations over angle and/or electron energy yielded singly differential and total electron production cross sections. The total cross sections for oxygen fall halfway between previous data of deHeer et al. and Hooper et al., but the argon cross sections agree better with deHeer et al. Cross sections for electron ejection in the backward hemisphere are much greater for these multishell targets than for hydrogen and helium. The momentum–energy conservation hump that was prominent in hydrogen is less conspicuous for these gases. (auth)

24893 COMPARISON OF EXPERIMENTAL AND THEORETICAL VALUES OF CROSS SECTIONS FOR ELECTRON PRODUCTION BY PROTON IMPACT. Rudd, M. E.; Gregoire, D.; Crooks, J. B. (Univ. of Nebraska, Lincoln). Phys. Rev., A; 3: 1635-40 (May 1971).

Angle and energy distributions of electrons ejected from single- and multishell atoms by 50- to 300-keV protons are compared with various theoretical treatments. Partial cross sections for each subshell are calculated by scaling according to the number of electrons and the binding energy and then are added. The Born approximation fails at large and at small angles but yields fair agreement at intermediate angles. The treatments of Salin and of Macek, which take account of the influence of the projectile after the collision, yield much improved agreement at small angles. The binary-encounter model is used to calculate cross sections that are differential only in electron energy. An analytical expression is given for the binary-encounter cross section averaged over the Fock hydrogenic distribution of orbital velocities. When the average orbital energy is calculated from Slater's rules, the results agree somewhat better with experiment than when this energy is set equal to the binding energy. (auth)

24894 ION–ION MUTUAL NEUTRALIZATION CROSS SECTIONS MEASURED BY A SUPERIMPOSED BEAM TECHNIQUE. II. $O_2^+ + O_2^-$, $O_2^+ + NO_2^-$, AND $NO^+ + NO_2^-$. Peterson, James R.; Aberth, William H.; Moseley, John T.; Sheridan, J. Roger (Stanford Research Inst., Menlo Park, Calif.). Phys. Rev., A; 3: 1651-7(May 1971).

Two-body ion–ion neutralization cross sections Q were measured for $NO^+ + NO_2^-$ and $O_2^+ + NO_2^-$ and remeasured for $O_2^+ + O_2^-$. Using a superimposed-beams method, a range of barycentric energies between 0.15 and 200 eV was covered. The product v_rQ behaved somewhat similarly for all reactants when plotted against the relative speed v_r. For relative energies above 3 eV, v_rQ varies slowly and is of a magnitude of 10^{-7} cm^3/sec or greater. Below about 3 eV, however, v_rQ begins to increase rather rapidly with decreasing energy, approaching the expected v_r^{-1} dependence. The low-energy data were fitted to four-term polynomials in powers of v_r. In this form the data can be extrapolated to the thermal range and rate constants obtained. Reaction rates (300°K) are given for the above reactants and also for $H^+ + H^-$, $O^+ + O^-$, $N^+ + O^-$, and $N_2^+ + O_2^-$, which were studied earlier. (auth)

24895 PRODUCTION OF ULTRAHIGH CHARGE STATES IN HEAVY-ION COLLISIONS. Ryding, G.; Wittkower, and Rose, P. H. (High Voltage Engineering Corp., Burlington, Mass.). Phys. Rev., A; 3: 1658-65(May 1971).

Charge-state fractions were determined for iodine, selenium, and bromine ions traversing oxygen, argon, krypton, xenon, carbon-foil, and gold-foil targets. Particular attention has been paid to high charge states, some containing as little as 10^{-6}% of the primary beam intensity. Despite the fact that heavy-gas targets produce a low mean charge, they were found to be more efficient producers of very high charge states than lighter targets. For the very highest charge states recorded (>22+ for iodine ions at 12 MeV), the heaviest gas target Xe produced even more of these ions than a carbon foil. Measurements of the attenuation cross section and scattering for the ultrahigh charge states are also reported. (auth)

24896 EXCITATION OF HELIUM BY PROTON IMPACT. Tripathi, A. N.; Mathur, K. C.; Joshi, S. K. (Univ. of Roorkee, India). Phys. Rev., A; 3: 1666-70(May 1971).

The binary-encounter collision model for ionization of atoms by proton impact proposed by Gerjuoy and Vriens is extended to the problem of proton-impact excitation of a neutral atom from the ground state. The proton-excitation cross sections from the ground state of a helium atom to the n^1S (n = 2 to 5), n^1P (n = 2 to 5), and n^1D (n = 3, 4) states are calculated using a δ function as well as a quantal-momentum distribution function for the target electrons. The calculated cross sections are compared with other theoretical calculations and the measured values. (auth)

24897 POLARIZATION OF LITHIUM ATOM RESONANCE LINES EXCITED BY ELECTRON IMPACT. Feautrier, N. (Observatoire, Paris). J. Phys., B (London); 3: L152-4(Dec 1970).

The close-coupling method for atom–electron collisions is modified to take account of the full polarizability of the atomic states. This effect is tested on the calculations of the polarization of lithium atom resonance lines and the results are in better agreement with the measurements of Hafner and Kleinpoppen. (auth) (UK)

24898 STRUCTURE OBSERVED DURING DETAILED MEASUREMENTS OF DETACHMENT FROM H^- BY ELECTRON IMPACT. Walton, D. S.; Peart, B.; Dolder, K. (Univ. of Newcastle-Upon-Tyne, Eng.). J. Phys., B (London); 3: L148-9(Dec 1970).

Absolute cross sections for single detachment from H^- by electron impact were measured by an inclined beam technique. At interaction energies close to 14.5 eV the detachment function shows structure that is attributed to the formation of H^{2-} with a lifetime of the order of 10^{-15} sec. (auth) (UK)

24899 MULTIPLE SCATTERING EXPANSIONS FOR NONRELATIVISTIC THREE-BODY COLLISION PROBLEMS. II. CONVERGENCE OF THE FADDEEV–WATSON EXPANSION FOR REARRANGEMENT COLLISIONS. Chen, J. C. Y.; Hambro, L. (Univ. of Oslo). J. Phys., B (London); 4: 191-207(Feb 1971).

The convergence of the Faddeev–Watson multiple scattering

expansion is investigated for three-body rearrangement collisions, $1 + (2,3) \rightarrow (1,2) + 3$, for systems with Coulomb interactions and arbitrary masses. The matrix elements of the expansion are evaluated to the second order in the two-body T-matrix using the Nutt procedures. The result suggests that the expansion for rearrangement transition amplitudes $\langle\psi_1^{(3)}|T_\tau|\psi_1^{(1)}\rangle$ between ground two-body states converges in the high energy limit as $\langle\psi_1^{(3)}|T_\tau|\psi_1^{(1)}\rangle = (1/k^6)[a_0 + (a_1/k) + (a_2/k^2) + \ldots]$ for a nonrelativistic three-body Coulomb system with arbitrary masses. The effect of the constituent particle masses on the rate of approaching this high-energy behavior is discussed. It is pointed out that the controversies regarding the role of proton–proton interaction in electron-transfer collisions for the (p^+,H) system arise from the improper high-energy behavior of the Born series. (auth) (UK)

24900 ELECTRON SCATTERING BY COMPLEX ATOMS. Burke, P. G.; Hibbert, A.; Robb, W. D. (Queen's Univ., Belfast). J. Phys., B (London); 4: 153-61(Feb 1971).

A theory of electron scattering by complex atoms is developed in which the target- atom eigenstates and pseudostates are written as linear sums of configurations and the incident-electron wave function is expanded in terms of orbitals that satisfy logarithmic boundary conditions on the surface of a sphere. The radius of the sphere is chosen so that exchange between the scattered and atomic electrons is only important within the sphere, but full allowance must be made for the long-range atomic potentials that exist outside the sphere. Both the bound and the continuum calculations involve a diagonalization of the Hamiltonian in the appropriate basis, and these calculations are arranged so that they use the same analytic procedures and computer codes. Finally, the construction of the S-matrix and the cross-section matrix is discussed. (auth) (UK)

24901 ELECTRON LOSS FROM FAST METASTABLE HYDROGEN ATOMS PASSING THROUGH ATOMIC HYDROGEN AND HELIUM. Bell, K. L.; Kingston, A. E. (Queen's Univ., Belfast). J. Phys., B (London); 4: 162-7(Feb 1971).

The first Born approximation is used to calculate cross sections for electron loss from fast metastable hydrogen atoms passing through atomic hydrogen and atomic helium. Full account is taken of double transitions, and in the case of a helium target the calculations are performed using length and velocity formulation values of the Born matrix elements. The results are remarkable for their prediction of double maxima in the cross sections and for the excellent agreement in shape with experiment over the energy range (10 to 30 keV) between the maxima. (auth) (UK)

24902 DIFFERENTIAL CROSS SECTIONS FOR THE ELASTIC SCATTERING OF ELECTRONS BY HELIUM ATOMS. Khare, S. P.; Shobha, P. (Meerut University Inst. of Advanced Studies, India). J. Phys., B (London); 4: 208-14(Feb 1971).

The differential cross sections for the elastic scattering of 100- to 500-eV electrons by helium atoms are calculated in the plane-wave approximation. The interaction potential consists of the first-order static potential and the second-order adiabatic and nonadiabatic polarization potentials. An alternative derivation of the asymptotic value of the nonadiabatic potential is presented, and the second-order scattering amplitude is compared with the second Born amplitude. In the calculation of differential cross sections the effect of exchange is included by employing the Ochkur approximation, and terms up to only third order in the interaction energy are retained. The cross sections are within 15% of the experimental values. Similar agreement is obtained with more sophisticated calculations. (auth) (UK)

24903 ELECTRON DETACHMENT IN $H–H^-$ AND $O–O^-$ COLLISIONS. Janev, R. K.; Tancic, A. R. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). J. Phys., B (London); 4: 219-23(Feb 1971).

In the framework of the impact-parameter method, a formula for the collisional detachment cross section is derived and expressed in terms of averaged level widths of the quasi-stationary molecular states and the stabilization distances for auto-ionization. Using this formula, the cross sections for $H–H^-$ and $O–O^-$ electron detachment are calculated, and a comparison is made with the experimental data and previous theoretical calculations. (auth) (UK)

24904 STUDY OF PROTON CHARGE EXCHANGE WITH THE FORMATION OF ATOMS IN EXCITED STATES. Le Doucen, R.; Lenormand, J. M.; Guidini, J. (Rennes Univ., France). J. Phys. (Paris); 31: 965-70(Nov-Dec 1970). (In French).

A study was made of proton charge-exchange processes resulting in the capture of an electron in an excited state ($9 \leq n \leq 23$) in the energy range 20 to 150 keV. The cross sections for capture in a state n were determined. Rare gases or the molecular gases H_2, N_2, O_2, NH_3, C_2H_2, or C_6H_6 were used as targets. The change in the composition of the beam was investigated as a function of the target density. The cross sections for stripping of hydrogen atoms in excited states were calculated. (auth) (France)

24905 METASTABLE ATOM AND THE ATOMIC COLLISION PHYSICS. Bull. Inform. Sci. Tech. (Paris); No. 152, 19-35(Oct 1970). (In French).

The long lifetimes of metastable atoms account for the important role they play in atomic collisions. Considerations are presented on the lifetimes of the excited states and their de-excitation, collisions of metastable atoms with atoms and molecules, the production of a beam of metastable atoms, and the detection of metastable atoms present in a beam. In particular, the experiment of Emeraude on the formation and detection of a metastable hydrogen beam in the $2^2S_{\frac{1}{2}}$ state and inelastic collisions between these metastable atoms and atoms and molecules is described. (auth) (France)

24906 INVERSE PROBLEM IN ATOM–ATOM SCATTERING IN WKB APPROACH. II. TOTAL CROSS SECTIONS. Vollmer, G. (Univ., Freiburg i. B.). Z. Phys.; 243: 92-104(1971).

The quasi-potential method is used to study the K dependence of Q(t,K) in detail. A new simple ansatz for the quasi-potential is given, which describes all important features of the interaction potentials and may be integrated to yield a simple analytic expression for the phase function. The essential quantities of the latter are explicitly computed with their dependence upon energy and the potential parameters. Thus, the total cross section is given by a simple final formula including the glories. For all terms the high-energy 1/K expansion can be derived. The cross-section formulas facilitate the determination of interatomic interactions. (auth)

24907 COULOMB T-MATRIX AND ELECTRON CAPTURE BY PROTONS PASSING THROUGH HYDROGEN. Kumar, Lalit. Baton Rouge, La.; Louisiana State Univ. (1970). 120p. University Microfilms Order No. 71-3421.

Thesis.

A Faddeev-type expansion is derived for the transition amplitude for the electron-capture process in proton-hydrogen scattering. Using Nutt's expression for the two-particle off-energy-shell Coulomb T-matrix and considering the terms through second order in Faddeev's expansion, an expression for the charge-exchange amplitude is derived for this process. The results of numerical calculations are compared with the corresponding results for the cross section at high energies as given by the numerical formula: $\sigma^{(1)} = \sigma^{BK}[1 + 0.281/\sqrt{E} + 0.261/E]$ where σ^{BK} is the Brinkmann–Kramers cross section and E is the energy of the incident proton in units of 100 keV. At high energies, an analytical expression for the cross section, retaining only the terms through first order in T-matrix in the expansion for the transition operator, is obtained. In the high-energy limit, these results approach the Brinkmann–Kramers formula. (Diss. Abstr. Int., B)

24908 TEST OF THE POLARIZED ORBITAL METHOD. Oberoi, Ranjit Singh. Baton Rouge, La.; Louisiana State Univ. (1970). 97p. University Microfilms Order No. 71-3430.

Thesis.

The polarized-orbital method of scattering theory and many of the common variations and approximations of this approach are tested in a computation of the binding energy of the negative hydrogen ion, H^-. It is found that if a trial wave function for H^- is constructed from a distorted atomic wave function in which the first-order perturbed orbital is simply added to the undistorted atomic wave function, the result is a very poor approximation (binding energy –0.0094 rydberg). However, if the trial wave function is modified as suggested by Drachman with the introduction of an additional independent function multiplying the perturbed orbital, the result is quite good, the binding energy being –0.0544 rydberg. For comparison, the essentially exact value (due to Pekeris) is –0.0555 rydberg. Several approximations of a non-variational type are also considered. These include the following methods: adiabatic exchange (dipole), adiabatic exchange (total), extended polarization, and the Temkin–Lamkin approach. Drachman's modification of the polarized-orbital wave function is also used in conjunction with the Harris variational method to determine low-energy s-wave phase shifts for both singlet and triplet states in electron–hydrogen scattering. Excellent agreement with the "exact" results of Schwartz is obtained. (Diss. Abstr. Int., B)

24909 BREMSSTRAHLUNG AND PAIR PRODUCTION FOR SCREENED POTENTIAL MODELS. Tseng, Hsiang-kuang. Pittsburgh; Univ. of Pittsburgh (1970). 163p. University Microfilms Order No. 71-3527.

Thesis.

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A discussion of relativistic bremsstrahlung cross sections is given for incident-electron kinetic energies in the range 5 keV to 1 MeV, based on an exact numerical calculation of screened potentials. Comparisons are made with previous authors and with experiment. Exact point Coulomb and Born approximation results are contrasted. The present results show that the Born approximation significantly underestimates the bremsstrahlung cross sections in the energy region considered. Screening effects are somewhat larger than expected and when large are not well described by a form factor. Some representative results for polarization correlations are also given. For high-Z elements Coulomb corrections and screening corrections to unpolarized cross sections are different from corrections to polarized cross sections. For pair production some sample unpolarized point Coulomb cross sections are presented; they agree well with the results of Øverbø, Mork, and Olsen. (Diss. Abstr. Int., B)

24910 MOLECULAR-BEAM STUDY OF THE K + I_2 REACTION: DIFFERENTIAL CROSS SECTION AND ENERGY DEPENDENCE. Gillen, Keith T.; Rulis, Alan M.; Bernstein, R. B. (Univ. of Wisconsin, Madison). J. Chem. Phys.; 54: 2831-51 (1 Apr 1971).

A molecular-beam study of the reactive and nonreactive scattering of a velocity-selected K beam crossed with a thermal I_2 beam is described. Velocity analysis yielded the recoil velocity–angle distribution of product KI flux. The energy dependence of this flux distribution was determined from measurements at several incident K beam velocities, corresponding to a range of collision energies $\bar{E}$ from 1.9 to 3.6 kcal/mole. Computational methods were developed to extract the center-of-mass differential reactive cross-section functions (angular and recoil-energy distributions) from the laboratory data. In accord with previous literature on related systems, the reactive cross section is "forward peaked" and most of the exoergicity (some 40 kcal/mole) goes into internal excitation of the KI product. However, there is also significant KI scattering at wide angles and with large recoil energies. The center-of-mass angular and recoil-velocity distributions are somewhat coupled (i.e., nonfactorizable). An increase in $\bar{E}$ from 1.9 to 3.6 kcal/mole produces only a slight change in the shape of the center-of-mass differential cross section, accompanied by a small decrease (≈20%) in the magnitude of the reaction cross section. Measurements were also made on the angular and velocity distributions of the nonreactively scattered K over the same energy range. (auth)

24911 DISSOCIATION BY ELECTRON IMPACT OF OXYGEN INTO METASTABLE QUINTET AND LONG-LIVED HIGH-RYDBERG ATOMS. Freund, Robert S. (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Chem. Phys.; 54: 3125-41(1 Apr 1971).

Excitation of O_2 by low-energy electrons leads to its dissociation with the formation of metastable oxygen atoms. The metastable atoms detected are in the $3s^5S^0$ state at 9.14 eV and in long-lived high-Rydberg states. A molecular beam time-of-flight method is used to measure their translational energy. Electron-impact excitation functions are given for the formation of metastable atoms. High-Rydberg atoms result from dissociation of initially formed high-Rydberg molecules. Because a high-Rydberg molecular orbital is nonbonding, dissociation is determined by states of the core O_2^+ ion. This mechanism is supported by general agreement between the observed kinetic-energy distribution of high-Rydberg atoms and the kinetic-energy distribution of O^+ from dissociative ionization of O_2. The fragment kinetic-energy distributions are discussed in terms of known and predicted states of O_2 and O_2^+. (auth)

24912 THEORETICAL INVESTIGATION OF INELASTIC COLLISIONS OF ELECTRONS WITH MOLECULES. Poshyunaite, N. P.; Lukoshyus, P. P.; Bolotin, A. B. (Vilnyus State Univ., USSR). Liet. Fiz. Rinkinys, Liet. TSR Mokslu Akad., Liet. TSR Aukst. Mokylos; 10: 229-37(1970). (In Russian).

Using Born, Born–Ochkur, and Vainshtein–Presnyakov–Sobelman approximations together with the MO LCAO approximation, the exitation of methane and ethane from the ground state to the lower excited states by electron impact was investigated. (auth)

24913 CHARGE TRANSFER BETWEEN ALKALI ATOMS AND OXYGEN MOLECULES. Moutinho, A. M. C.; Baede, A. P. M.; Los, J. (FOM-Instituut voor Atoom- en Molecuulfysica, Amsterdam). Physica; 51: 432-44(15 Feb 1971).

Charge-transfer cross sections were measured for collisions between alkali metal atoms and oxygen in the eV range. The experiments showed that these collisions not only produce positive and negative ions but also free electrons. The results further suggest the occurrence of dissociative charge transfer at sufficiently high energies. The electron affinity of the O_2 molecule, as obtained from the threshold of charge transfer, is 0.8 ± 0.2 eV. A qualitative interpretation of the results is given in terms of curve crossing, assuming that the Franck–Condon principle holds for the electron attachment. (auth)

24914 MULTICHANNEL RESONANCES IN EXCITATION OF HELIUM BY ELECTRONS AT ENERGIES NEAR 60 eV. Heideman, H. G. M.; Van Dalfsen, W.; Smit, C. (Rijksuniversiteit, Utrecht). Physica; 51: 215-21(29 Jan 1971).

The excitation of the 4^3S, 4^1S, 3^3P, 3^1P, 3^3D, 4^3D, and 4^1D levels of helium by electron impact was studied by observing the light emission following the excitation of the levels concerned. The electron-energy region considered extends from 55 to 62 eV. The measurements show that in this energy range a number of resonances occur in the optical excitation curves. In the 3^3D and 4^3D excitation a resonance is found that is very large compared to the resonances observed in the other channels. The observed resonances can be explained in terms of intermediate negative-ion states associated with doubly excited states of the neutral helium atom. (auth)

24915 RELATIVE ROLE OF VARIOUS IONIZATION PROCESSES IN SLOW COLLISIONS OF K^+ IONS WITH INERT-GAS ATOMS. Afrosimov, V. V.; Gordeev, Yu. S.; Lavrov, V. M.; Shchemelinin, S. G. (Ioffe Inst. of Physics and Tech., Leningrad). JETP Lett. (USSR) (Engl. Transl.); 12: 317-19(20 Nov 1970).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 12: 455-8 (20 Nov 1970).

The kinetic energy of K^+ ions after collisions with Ne, Ar, and Xe targets was analyzed in order to determine the relative importance of various ionization processes. The study involved initial ion energies of 1 to 3 keV, the energy-loss region from 0 to 50 eV, and lab scattering angles from 1 to 10°. It is concluded that, in the energy region investigated, the ionization of Ar and Xe by K^+ ions is determined almost completely by the autoionization process and by the process of ionization with excitation. Processes of direct ionization and double ionization contribute only a few per cent each. In the case of K^+ scattering by Ne, no energy losses connected with autoionization or ionization with excitation were observed. (A.G.W.)

24916 STUDY OF THE INFLUENCE OF THE PEAK APPROXIMATION ON DETERMINATION OF THE ELECTRON-IMPACT EXCITATION CROSS SECTIONS OF THE H ATOM, CALCULATED BY THE V. P. S. APPROXIMATION. Felden, Madeleine (Nancy Univ.). Compt. Rend., Ser. B; 272: 84-7(11 Jan 1971). (In French).

The e–H cross section for the 1s → 2s transitions and ionization are calculated in the Born and VPS approximations. In the second method it is necessary to use a peak approximation to calculate the matrix elements. This peak approximation accounts for the differences between the results at energies less than 150 eV. (auth) (France)

24917 DISSOCIATION OF 10 keV $(HeH)^+$ MOLECULAR IONS. II. He^+ FRAGMENTS. Schopman, J.; Los, J.; Maas, J. (FOM-Instituut voor Atoom- en Molecuulfysica, Amsterdam). Physica; 51: 113-31(19 Jan 1971).

The He^+ fragments of $(HeH)^+$ molecular ions dissociated by collision with various target gases are considered. The angular dependence of the scattering of the He^+ fragments was measured with respect to the center of mass of the molecular ion for different energies above the dissociation limit. From the results it is evident that both electronic excitation and hard collisions contribute to the dissociation. The large asymmetry in the distributions in forward and backward directions could be explained by the strong polar character of the molecular ion. Dissociation of $(HeH)^+$ into He^+ and H also can be caused by a Van der Waals excitation of its first excited states. This has become clear from the momentum distributions measured in the center of mass of the molecular ion in forward and backward directions with respect to the beam. The dependence of the intensity on the polarizability of the target atom is in agreement with the theory derived by Russek. (auth)

24918 DISSOCIATION OF 10 keV $(HeH)^+$ MOLECULAR IONS. III. THE INFLUENCE OF EXCITED STATES. Schopman, J.; Los, J. (FOM-Instituut voor Atoom- en Molecuulfysica, Amsterdam). Physica; 51: 132-45(19 Jan 1971).

Certain aspects of the velocity distribution of the He^+ fragments from the collision-induced dissociation of HeH^+ could be explained only by assuming that the primary beam contains a fraction of molecules in the first excited singlet or triplet state.

This assumption was verified by performing inelastic loss measurements for HeH^+ colliding with noble gas target atoms. Moreover, these excited molecules upon collision with a target atom give rise to dissociation into a helium atom and a proton with energies barely above the dissociation limit. It is shown that interference effects lead to resonances in the cross section for those fragments flying off parallel to the beam. This explains the fine structure in the observed proton spectrum of dissociating HeH^+. It is inferred that the same spectrum observed in the dissociation of HeH^+ without gas in the collision chamber also might be due to induced de-excitation of these excited molecules. The dissociation of NeH^+ and NeD^+, being molecules very similar to HeH^+, might be expected to exhibit the same features. This indeed was observed. The existence of stable HeH could be verified by charge exchange in the HeH^+ beam. (auth)

Atomic Theory

24919 EVALUATION OF APPROXIMATIONS TO HARTREE–FOCK EXCHANGE. Folland, N. O. (Kansas State Univ., Manhattan). Phys. Rev., A; 3: 1535-43(May 1971).

Approximations to the Hartree–Fock (HF) exchange energy density were derived directly from the HF exchange energy density. The approximations involving two free parameters take the form of a Kohn–Sham–Gaspar (KSG) exchange energy density plus inhomogeneity corrections. The approximation including lowest-order inhomogeneity corrections only is equivalent to the approximation recently proposed by Herman, Van Dyke, and Ortenburger. An approximation including the next-higher-order inhomogeneity corrections with no additional parameters is also derived. The approximations were evaluated by direct comparison with the actual HF exchange energy density for Ar and Cu^+ The optimum choices of parameters in the case of the approximation including lowest-order inhomogeneity corrections are in excellent agreement with the corresponding values found by Herman et al., and are independent of the atomic system considered. The approximation including higher-order inhomogeneity corrections did not significantly improve the approximation including lowest-order inhomogeneity corrections. However, the higher-order approximation is of interest in that it does lead to an angular-momentum-dependent exchange potential. (auth)

24920 ELECTRON CORRELATION IN THREE-ELECTRON ATOMS AND IONS. White, Ronald J.; Stillinger, Frank H. (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., A; 3: 1521-35 (May 1971).

Electron correlation in three-electron atoms and ions is studied in two important regions of configuration space: the vicinity of the nucleus, and the vicinity of three-electron coalescence away from the nucleus. In both cases, weakly singular logarithmic behavior of the wave function is obtained. A study is made of the nodal characteristics of the wave function near the nucleus. Model systems are introduced, which reflect some of the salient features present in the actual atomic system. Suggestions are made as to the utility of the present type of analysis with special attention to the recent transcorrelated approach to the Schrödinger equation. (auth)

24921 GROUP PROPERTIES OF HYDROGENIC RADIAL FUNCTIONS. Armstrong, Lloyd Jr. (Johns Hopkins Univ., Baltimore). Phys. Rev., A; 3: 1546-50(May 1971).

The radial wave functions of hydrogen are put into such a form that they form bases for irreducible unitary representations of an algebra isomorphic to that of O(2,1). Operators proportional to r^k are found, which form bases for the adjoint representations of this algebra. Matrix elements of these operators are evaluated, and selection rules are determined by considering Kronecker products of representations of O(2,1). Differences between this approach and one previously suggested are discussed. (auth)

24922 SUPERRADIANCE. Rehler, Nicholas E.; Eberly, Joseph H. (Univ. of Rochester, N. Y.). Phys. Rev., A; 3: 1735-51 (May 1971).

A straightforward quantum-electrodynamic approach to the problem of superradiant spontaneous emission from a system of two-level atoms is introduced, and two classical superradiant systems are discussed. The same physical concepts underlie the treatment of both the quantum and classical cases. Explicit expressions are found, which describe the time evolution and directional character of the radiated power. The approach applies to an arbitrary number of atoms confined to a region with linear dimensions that may be large compared with the mean wavelength of the emitted radiation. The radiative decay half-life of a large many-atom system is found to be much shorter than the natural lifetime of a single atom but not as short as the half-life of a small atomic system with the same number of atoms. The far-field radiation pattern appropriate to the case of a circular cylinder of emitters excited by a plane-wave pulse is considered in detail. Polar plots are presented of the radiation patterns produced when the atoms are excited by a plane-wave pulse. Exciting pulses traveling in directions both parallel and at an angle of 10° to the axis of the cylinder are considered. A discussion and generalization of Dicke's "coherence-brightening" criterion is given. (auth)

24923 MASTER-EQUATION APPROACH TO SPONTANEOUS EMISSION. II. EMISSION FROM A SYSTEM OF HARMONIC OSCILLATORS. Agarwal, G. S. (Univ. of Rochester, N. Y.). Phys. Rev., A; 3: 1783-93(May 1971).

In a previous investigation, a general theory for spontaneous emission from a system of N identical atoms or molecules was developed. This theory was based on the master equation recently derived in another paper. In that paper, the master equation relating to spontaneous emission from a system of harmonic oscillators was also derived. In the present investigation, the normally ordered correlation functions for the oscillator system are calculated, and these are then used to calculate the radiation-field correlation functions in the far zone. These correlation functions are compared for two different modes of excitation, viz., (i) when each of the oscillators is excited initially to a Fock state, and (ii) when each of the oscillators is excited to some coherent state. It is found that the even-order (2n) correlation functions for the second mode of excitation (superradiant excitation) are of order N^{2n} higher than those for the first mode of excitation. It is also shown that the photoelectron counting distribution for the superradiant excitation is Poissonian. Finally, the non-Markoffian effects in the spontaneous emission are studied in detail and their connection with exact results is described. (auth)

24924 RELATIVISTIC CORRECTIONS TO ATOMIC ENERGY LEVELS. Jones, M. (University Coll., London). J. Phys., B (London); 3: 1571-92(Dec 1970).

The relativistic effects on bound levels of atomic systems with particular application to systems of astrophysical importance are investigated by including the most important contributions to the low-Z Pauli approximation for the Hamiltonian. This work represents an extension of a general purpose computer program for calculating nonrelativistic energy levels of complex atoms, described by Eissner and Nussbaumer in 1969. Their algebraic approach has been adapted to the problems of evaluating matrix elements of the relativistic operators. In particular the program should give fairly good intermediate-coupling wave functions. Thus it may be used as a basis for the calculation of intermediate-coupling collision strengths and oscillator strengths. Numerical results are given for the magnesium I, sodium I, and fluorine I isoelectronic sequences. In each case the calculations reproduce the observed Z dependence of the term differences in a much more satisfactory way than the nonrelativistic calculations. Also, calculations of spin–orbit parameters are found to compare well both with observed and the calculated parameters of other workers. (auth) (UK)

24925 ATOM–EXCITED ATOM EXCHANGE INTERACTION AT LARGE DISTANCES. Janev, R. K. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). J. Phys., B (London); 4: 215-18 (Feb 1971).

For two atoms whose ionization potentials are considerably different, an exact asymptotic expression for the exchange interaction is derived. This interaction is connected with the energy-level shift of an excited atom colliding with a ground-state atom. From the general expression for this quantity, the results of Smirnov (1966) and Ovchinikova (1966) are obtained as special cases. (auth) (UK)

24926 STUDY OF SOME ANALYTICAL PROPERTIES OF GAUSSIAN ORBITALS. Roux, Monique (CNRS, Paris); Naon, Michele; Cornille, Marguerite. Compt. Rend., Ser. B; 272: 81-3(11 Jan 1971). (In French).

A relation between the p^m and r^m already introduced for the simple case of He atom is generalized for a basic orbital with a single gaussian function. (France)

24927 IMPROVEMENT OF THE CALCULATIONS OF THE ATOMS WITH OUTER 2p SHELLS. Kantseryavichyus, A. Yu. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys, Liet. TSR Mokslu Akad., Liet. TSR Aukst. Mokylos; 10: 193-200(1970). (In Russian).

Improvement of the radial part of the wave function of atoms having the configurations $1s^22p^N$, $1s^22s2p^N$, and $1s^22s^22p^N$ (N =

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2,3,4,5,6) by inclusion of correction terms is considered. Hartree–Fock orbitals are used as a zero approximation. The wave functions of the correction terms are constructed from simple Slater orbitals. The calculated energies, corrections to the Hartree–Fock energies, and some variational parameters of the correction terms are given. The corrections to the Hartree–Fock energies are especially important when the number of the equivalent electrons in the 2p shell is ≥4. (auth)

Cosmic Radiation

Refer also to abstract 24688, 24815, 25278, and 25284.

24928 (HASL–241) 1970 SEA-LEVEL COSMIC-RAY NEUTRON MEASUREMENS. Hajnal, Ferenc; McLaughlin, James E.; Weinstein, Martin S.; O'Brien, Keran (New York Operations Office (AEC), N. Y. Health and Safety Lab.). Feb 1971. 22p. Dep. NTIS.

Interest in low-level environmental radiation led to multisphere spectrometer measurements of sea-level cosmic-ray neutrons in New York City. 0.50 mRad/y was measured, corresponding to a neutron flux of 0.0082 n/cm^2-s. These results and those from HASL transport calculations agree fairly well with the 1966 estimates of the U.N. Scientific Committee that the annual neutron dose rate is about 0.70 mRad and the sea-level flux is about 0.010 n/cm^2-s. Comparison of the annual dose equivalent rates was also made with published values. Because the dose equivalent rates depend strongly on the model used, different slab geometries were evaluated to determine differences between surface and depth dose equivalent values for neutrons incident both normally and isotropically, and monolaterally and bilaterally, onto a 30-cm-thick tissue slab. (auth)

24929 RADIO-PULSE EMISSION FROM COSMIC-RAY AIR-SHOWERS. Shah, Navinchandra Jagmohandas. Ann Arbor, Mich.; Univ. of Michigan (1970). 80p. University Microfilms Order No. 71–4725.

Thesis.

Radio pulses from cosmic ray air-showers were detected in conjunction with the Bolivian Air-Shower Joint Experiment (BASJE) air-shower array, which permitted the measurement of the total number of charged particles, arrival direction, and core location. The experiment was carried out at Mt. Chacaltaya, Bolivia at an altitude of 5200 meters. Log-periodic antennas were used to detect the radio pulses. The showers with detectable pulses arrived predominantly from the general direction in which the antenna axis was pointing. The dependence of radio pulses on the shower parameters was investigated. The frequency of occurrence of these showers is well correlated with the shower size and the zenith angle. Since nearly all large-size showers and large-zenith-angle showers had detectable pulses, the radio pulses as a tool to detect these showers are very promising. The polarization of the radio pulses associated with air-showers was studied in order to test the mechanism of radio-pulse production. Antenna pairs with arms perpendicular to each other (north–south and east–west) were used. All proposed theories can be grouped according to four mechanisms, which predict different polarization directions. These predictions were compared with the pulses in the two antennas in each pair. The results of the polarization experiment indicate that the geomagnetic mechanism, which predicts polarization perpendicular to both the shower axis and the Earth's magnetic field, plays a dominant role in the radio-pulse emission. (Diss. Abstr. Int., B)

24930 EXTENSIVE AIR SHOWER AT 5200 METERS. Prewett, Omer Edward. Ann Arbor, Mich.; Univ. of Michigan (1970). 134p. University Microfilms Order No. 71–4711.

Thesis.

Electron–photon and nuclear-active particle components of extensive air showers of 10^5 to 10^6 particles were investigated. It was conducted at an altitude of 5200 meters on Mount Chacaltaya near La Paz, Bolivia. The principal instrument is a 60-inch cloud chamber. This chamber is located above a 60 m^2 shielded detector in the center of a large array of unshielded scintillation detectors. For each shower, the size, direction, and core location is calculated with the data from the array. The cloud chamber is used to find the density of the electrons and photons of the shower and the density of nuclear-active particles. The shielded detector is used to determine the energy of nuclear-active particles and the minimum number of nuclear-active particles in the shower. The lateral distributions of electrons and photons up to 10 meters from the shower axis have approximately the same slope at an altitude of 5200 meters as at lower altitudes when the distances are expressed in Moliere units. The lateral distributions of electrons and photons are flatter than those calculated for pure electron–photon cascades, especially at high altitudes and for high-energy electrons and photons. The energy spectra of electrons and photons at radii of 0.01 and 0.02 Moliere units have the same slopes at 5200 meters as at lower altitudes. Similarly, the slope of the energy spectrum of nuclear-active particles does not vary with altitude. (Diss. Abstr. Int., B)

24931 PROPAGATION AND CONFINEMENT OF COSMIC RAYS. Russo, Arturo; Scarsi, Livio. Rend. Semin. Mat. Fis. Milano; 39: 36–49(1969).

From Symposium in Honor of Giuseppe Occhialini on the 20th Anniversary of His Return to Italy, Milan, Italy. See CONF-681083.

The existing information on the large-scale structure of the Galaxy is summarized insofar as it is relevant to the definition of an eventual confining volume for charged cosmic particles at the galactic scale. Observational data on matter and magnetic-field distributions are considered. The relationship existing between the flux and energy spectrum of positrons and the nature of an eventual confinement volume is described. (W.D.M.)

24932 ATMOSPHERIC GAMMA-RAYS OF 1 TO 200 GeV OVER HYDERABAD. Stephens, S. A. (Tata Inst. of Fundamental Research, Bombay). Proc. Indian Acad. Sci., Sect. A; 72: 214-35(Nov 1970).

Using a stack of hypersensitized nuclear emulsions, exposed under 10.2 g/cm^2 of residual atmosphere over Hyderabad, India, gamma rays of energy >1 GeV were studied. It was found that the observed differential energy spectrum can be best represented by two power-law spectra, one for energies less than 30 GeV and the other for higher energies but with the same spectral index of 2.6; however, the intensities at energies greater than 30 GeV are about three times higher than what would be expected from the extrapolation of the spectrum at lower energies. The implication of this observation was examined. The neutral pion production spectrum over Hyderabad was derived from the gamma-ray spectrum. Using this information the energy spectrum of atmospheric electrons was deduced, and a comparison was made with the observed spectrum below the geomagnetic threshold energy over Hyderabad; therefrom, an upper limit of 0.5 particles/(m^2 sterad sec) was deduced for the flux of re-entrant albedo electrons above 2 GeV. (auth)

24933 STUDY OF THE COSMIC-PARTICLE GRADIENT PERPENDICULAR TO THE PLANE OF THE SOLAR EQUATOR. Trottet, Gerard (CNRS, Verrieres-le-Buisson, France). Compt. Rend., Ser. B; 272: 286-9(25 Jan 1971). (In French).

The biannual variation in cosmic-ray intensity observed by the world network of neutron monitors revealed their phase to be strongly dependent on the solar activity distribution in relation to the heliolatitude. A model for calculating the perpendicular intensity gradient is proposed for the period when the activity is distributed symmetrically with respect to the solar equator. It is shown that from the end of 1967 until the end of 1969 the cosmic-ray intensity increased on moving away from the solar equator. (auth) (France)

24934 MEASUREMENT OF PRIMARY COSMIC AND X RADIATION IN THE SOUTH AMERICAN ANOMALY AT AN ALTITUDE OF 90 KM. PART 1. MEASUREMENT OF THE PRIMARY COSMIC RADIATION INTENSITY. Becerra, N. E.; Ghielmetti, H. S. (Centro Nacional de Radiacion Cosmica, Buenos Aires). SPARMO Bull.; 4: No. 1-2, 43-50(Mar 1970).

A rocket was launched from Chamical (Argentina) on December 16, 1967. The object of the experiment was the measurement of the x-ray flux and spectrum near the top of the atmosphere, but the information obtained from the GM counters made it possible to measure the integral intensity of the primary cosmic radiation above the local geomagnetic cutoff. The counting rate of the counters as a function of time and the counting rate measured above the 40-km level are given as a function of the atmospheric depth. From the figure, it is observed that the counting rate remains essentially constant. The total intensity measured includes primary cosmic radiation, essentially composed of protons and α particles, plus reentrant as well as splash albedo radiations. Therefore, in order to derive the primary cosmic radiation, the contribution from the total atmospheric albedo must be subtracted. The value obtained does not statistically differ from the general average. (auth) (France)

24935 REPORT ON THE RESULTS OF THE BALLOON LAUNCHING CAMPAIGN WHICH TOOK PLACE IN ICELAND BETWEEN SEPTEMBER 1 AND OCTOBER 15, 1968. PART 1. PRELIMINARY RESULTS OF THE COSMIC-RAY MEASUREMENTS PERFORMED USING THE SPARMO-TYPE MULTIDIREC-

TIONAL DETECTORS. Dion, J.; Heristchi, Dj.; Legrand, J. P.; Pagnier, P.; Palous, M. (Observatoire de Paris, Meudon, France). SPARMO Bull.; 4: No. 1-2, 65-74(Mar 1970). (In French).

High-latitude measurements of the galactic cosmic radiation were made using balloon-borne multidirectional detectors of the SPARMO-type. An azimuthal anisotropy of about 20% with a maximum counting rate in the north direction and a minimum counting rate in the south direction was shown for particles above 100-MeV energy. The height dependence of the anisotropy indicates that it appears only at low particle energies and is probably due to some modulation of the flux of low-energy particles. A similar anisotropy was found in the proton flux that occurred during the solar-proton event of September 29, 1968. (auth) (France)

24936 SEMIDIURNAL ANISOTROPY OF GALACTIC COSMIC-RAY INTENSITY. Subramanian, G. (National Research Council of Canada, Ottawa). Can. J. Phys.; 49: 34-48(1 Jan 1971).

The semidiurnal variation of galactic cosmic-ray intensity is investigated using data from mainly high-counting-rate neutron and meson monitors during 1964–1968. It is shown that in order to explain the observed semidiurnal variation it is necessary that an anisotropy of cosmic-ray intensity be present in interplanetary space. The energy spectrum and the asymptotic latitude dependence of the anisotropy are then determined. The energy spectrum has a positive exponent close to +1 for the power law in energy. The strength of the anisotropy decreases more rapidly than $\cos\lambda$ with increasing asymptotic latitude λ, both $\cos^2\lambda$ and $\cos^3\lambda$ being acceptable. The distribution of cosmic-ray intensity in the range of heliolatitudes ±7.25° at the orbit of the Earth, obtained using data from the Ottawa neutron monitor, does not support the explanation of the semidiurnal variation based on the models of Subramanian and Sarabhai or Lietti and Quenby. (auth) (Canada)

Direct Energy Conversion

Refer also to abstract 23736 and 25144.

24937 (AE-410) GENERAL PHYSICS SECTION PROGRESS REPORT, FISCAL YEAR 1969–70. Braun, J. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Dec 1970. 91p. Dep. NTIS (U. S. Sales Only).

A separate abstract was prepared for each of the four parts of this report. (A.G.W.)

For abstracts of individual chapters see: 23736, 24938, 25109, and 25659.

24938 (AE-410, pp 5-34) THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF MHD FLOW. (Aktiebolaget Atomenergi, Studsvik (Sweden)).

From General Physics Section progress report, fiscal year 1969–70.

Effects of instabilities in a MHD channel and work on the electron–ion recombination problem for helium at high pressure are reviewed. Experiments concerning the helium afterglow MHD scheme and pure noble-gas MHD are described. For a high-pressure discharge experiment, mechanical and electrical design, diagnostic methods and problems are discussed. Preliminary channel calculations are performed. (Sweden)

24939 (JUL-689-TP) APPLIED MAGNETOHYDRODYNAMICS. NUMBER 5. MHD-NUCLEAR POWER STATIONS. Bohn, T.; Grawatsch, K.; Komarek, P.; Noack, G. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Technische Physik). Aug 1970. 231p. (In German). Dep. NTIS (U. S. Sales Only).

In the attempt to give as comprehensive-as-possible representation of the problems of future MHD–nuclear power plants, it was necessary to analyze approximately all components present in such a power plant (reactor, MHD generator, transformer, superconducting magnet, heat exchanger, seed-material circuit, turbines, high-temperature transmission), which from the requirements are unconventional development products. Parametric studies of the possible design data of the MHD generators were first made. From these studies it was clear what specifications must be placed on the usual components of power plants and which design data of the channel must be chosen so that the necessary development of other components appears possible. The estimation of these limits was made on the basis of some technological studies made with the Argas, which with the exception of the reactor, contains all essential components of such a reactor. The analysis of the turbines, heat exchanger, high-temperature transmission, and electrical transformer shows that the construction with design data for a large power plant can be carried out with present technological know-how. The MHD channel, superconducting magnet, and seed-material circuit need intensive development studies. Technological problems still open are the stability of large superconducting magnets at high magnetic field strengths and the seed-material deposition. The biggest development problem lies in the area of high-temperature reactors. The increase of the gas outlet temperature to 2000°C assumes great improvements in the sector of coated-particle technology. The problems of an additional temperature increase by introduction of a high contamination of the primary circuit were considered. Circuit optimization and cost studies were made. It was found that the costs of the individual components, with the exception of the reactor, are already well known. (tr-auth)

24940 DEVELOPMENT OF LONG-DURATION MHD GENERATOR. Kasahara, Tatsuo (Hitachi Ltd., Ibaraki, Japan); Kazawa, Yoshiaki; Ishibashi, Eiichi; Sasaki, Yutaro; Masai, Tadahisa. Hitachi Hyoron: 51: 1002-5(Nov 1969). (In Japanese).

An MHD generator for extended operation manufactured for tests is described. The apparatus was designed for maximum electric output of ~2 kW for continuous operation of 100 hr, while the thermal input is ~3600 kW. Light and heavy oils were used as fuel. The oxidizing agent used was oxygen-rich air. Insulating walls and electrodes give rise to trouble since they are subjected to the erosive action of high-speed working gas at the temperature above 2000°K. The insulating walls used for the experimental apparatus were two kinds of cooled-wall type. The electrodes were mainly of water-cooled metal and some composite ceramic type. The duct of the generator was 30 mm in height × 120 mm in width, and its effective length was 600 mm. The electromagnet had 160-mm pole width, 700-mm length and 130-mm gap, with which the flux density of 1.9 tesla was obtained in continuous operation. In a test, a continuous operation of 110 hours, which exceeded the goal, was successfully achieved with this apparatus, in which an air-film cooled wall was used. Detailed discussion of electrodes and insulating walls is presented. (Japan)

24941 STUDY OF SEMI-HOT WALL DUCT FOR MHD GENERATOR. Morikawa, T.; Murai, Y.; Kobayashi, Y. (Mitsubishi Electric Corp., Amagasaki, Japan). Elec. Eng. Jap. (Engl. Transl.); 90: 121-7(Jan-Feb 1970).

The wall and electrode materials of the semi-hot wall MHD generator duct were investigated. The ceramic insulating wall has a limitation in withstanding the high-temperature gradient. Hence, the contact between the ceramics and the water-cooled metal plates is improved by soldering the metallized ceramic pieces to the metal plates. To minimize the thermal stress, the ceramic material is divided into several pieces. The heat loss from the gas flow to the wall is calculated on the basis of the enthalpy difference between the gas and wall. The results show good agreement with the measured ones. (auth)

24942 PROBLEM OF LOAD FACTOR IN CALCULATIONS OF MHD GENERATORS. Pelz, Pavel (Czechoslovakia Akademie der Wissenschaften, Prague). Acta Tech. CSAV; 15: 690-705(1970).

The use of the load factor in optimization calculations of the operation parameters of MHD generators is criticized, and the use of a load resistance and specific conductivity of the working medium is shown to be a better choice. The load factor K can be considered as a relative value of the transverse component of the electric field intensity and hence can be used in the classification of the operation parameters of a MHD machine. An operation characteristic $K = K(P)$, where P is the relative electromotive force of the outer source, is proposed for following the operation through the generator, motor, and brake regimes. (D.L.C.)

Fluid Physics

24943 UNSTEADY FLOW OF GASES IN CHANNELS INDUCED BY THE MOTION OF A PISTON IN THE CASE OF MAGNETOHYDRODYNAMIC ENERGY REMOVAL AND GAS DE-EXCITATION. Batazhin, A. B. Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza; No. 5, 17-25(Sep-Oct 1970). (In Russian).

The one-dimensional, nonstationary gas flow induced by the motion of the piston in the presence of weak perturbing forces and heat sources was examined. As a result of the study, the perturbing factors were identified thus solving the differential equations. Thus, the determination of the distribution of the gas parameters between the piston and the shock wave, determining the factors which accelerate or decelerate the shock wave front, was possible. The nonstationary motion of a conducting gas in a duct with continuous, energy-generating

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electrodes was examined, assuming that the medium was optically transparent. The theoretical derivation was used to solve the problem of a thin wedge moving at supersonic speeds in the external axial magnetic field, taking into account the de-excitation of the heated gas layer between the wedge and the shock wave. In order to generalize the findings, the perturbed flow equations were solved without specifying the perturbing factors, such as the forces and the heat sources. (TTT)

24944 CALCULATION OF QUASI-ONE-DIMENSIONAL FLOW OF AN IONIZED GAS IN A PROFILED CHANNEL. Brushlinskii, K. V.; Morozov, A. I.; Paleichik, V. V. Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza; No. 5, 29-32(Sep-Oct 1970). (In Russian).

The behavior of an ionized gas stream, created by a flat nozzle was investigated, using the quasi-one-dimensional approximation. The stream was accelerated by the action of a transverse magnetic field. The gas, which was not ionized at the inlet point, was heated up in the tapered section of the duct and became completely ionized. The numerical integration of the magnetohydrodynamic equations was used for examining the ionization process and the flow characteristics. The results revealed that no steady-state flow conditions were established. The fluctuating ionization front yielded a pulsed flow. As a result of the chosen initial conditions, the plasma was accelerated from left to right in the duct. The initial density, temperature, and magnetic field voltage were expressed by a monotonously decreasing function along the duct. In order to overcome difficulties in the calculation, it was assumed that the gas had a small but finite conductivity. The high-current discharge was found to be accompanied by a strong ultraviolet radiation, which causes a noticeable ionization of the gas. (TTT)

24945 GENERALIZATION OF GRAD'S THIRTEEN-MOMENT METHOD TO MAGNETOGASDYNAMICS. Wong, Lawrence Tsi-kong. East Lansing, Mich.; Michigan State Univ. (1970). 81p. University Microfilms Order No. 71-2197.

Thesis.

The thirteen-moment method developed by Grad, valid in neutral gases is generalized to one-component charged gases. A distribution function is defined as the mass density of particles in a one-component, homogeneous, uniformly charged gas. Several moments of distribution function are defined as symmetrical tensors. The Boltzmann equation is multiplied by a summational invariant and integrated over the velocity space. By setting the summational invariant equal to unity, velocity and velocity square, the Boltzmann equation yields the continuity, momentum, and energy equations, respectively. Using Hermite polynomial approximation, the equations of time, physical and velocity space variation of the second and third order tensors are obtained from the Boltzmann equation. These equations, along with the conservation equations, constitute the system of thirteen-moment equations. By considering a one-dimensional heat flow in a gas at rest and a plane Couette flow, the thermal conductivity and the coefficient of viscosity are deduced from the system of thirteen-moment equations. By considering a one-dimensional heat flow in a gas at rest and a plane Couette flow, the thermal conductivity and the coefficient of viscosity are deduced from the system of thirteen-moment equations. (Diss. Abstr. Int., B)

24946 THEORY OF CONDUCTIVE BUT NONMAGNETIC LIQUIDS IN TIME-VARYING MAGNETIC FIELDS. Papadopoulos, Demetrios P. Milwaukee; Marquette Univ. (1970). 121p. University Microfilms Order No. 71-5310.

Thesis.

First, the most general mathematical laws governing the interaction phenomena of electromagnetic fields and electrically conducting fluids are formulated. In accomplishing this, time-varying electromagnetic fields and fluids of viscous, incompressible, electrically conductive nonpolarizable, nonmagnetic, and Newtonian type were considered; displacement currents, currents arising from charge transport, forces on concentrations of free charge, and gravitational forces were neglected; and a nonrelativistic approach was employed. Second, a rectangular channel occupied by a liquid—with the above characteristic—at rest, and constrained from moving either conceptually or physically, to which a traveling magnetic field is applied was completely analyzed. The object of this analysis is the exact mathematical determination of very important quantities, such as current density, magnetic flux density in the liquid and the channel walls, and also the electromagnetic (Lorentz) forces developed in the liquid. (TSS) (Diss. Abstr. Int., B)

24947 CALCULATION OF THE PROPAGATION OF A SHOCK WAVE IN A MAGNETOGASDYNAMIC CHANNEL. Zaitsev, S. G.; Favorskaya, I. K. Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza; No. 5, 180-4(Sep-Oct 1970). (In Russian).

The flow of an ionized gas behind a shock wave propagating in a magnetogasdynamic channel was studied, using the one-dimensional flow approximation, without taking into account the effect of the induced field. On the basis of the study, the propagation of shock waves in argon with a Mach number of about 12 was determined. Under the conditions examined, the magnetogasdynamic parameter was larger than unity. The values determined included the flow conditions in the duct, the intensity of the drag due to pondero-motive forces in the duct, and the effect of the process itself on the movement of the original shock wave. A calculation method involving the magnetogasdynamic equation system with artificial viscosity was used for obtaining a numerical solution. This method is based on an artificial dissipative process which allows the changing of the parameters at points in which the gasdynamic parameters are disrupted without changing their values in regions of continuous flow. Although some simplifying assumptions are used, the calculation method makes it possible to describe the propagation of shock waves in pulsed magnetogasdynamic ducts. (TTT)

24948 LAMINAR FLOW OF AN ELECTROCONDUCTIVE LIQUID IN CYLINDRICAL DUCTS UNDER THE INFLUENCE OF A TRAVELLING MAGNETIC FIELD. Petrovich, R. A.; Ulmanis, L. Ya. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 6, 67-71(1970). (In Russian).

A numerical solution of nonlinear system of MHD equations for the laminar flow of an electroconducting liquid in an infinitely long round pipe under the influence of a traveling magnetic field is given. An analysis of the calculation results is added. Integral values of the calculation are compared with those obtained as a result of solving an analogous problem for a flat channel as well as with the ones obtained as a result of calculation according to an elaborate method for a solid conducting cylinder. (auth)

24949 CALCULATION OF THE FLOW OF AN ELECTRICALLY CONDUCTING FLUID IN A RECTANGULAR CHANNEL WITH ELECTRODES. Yakubenko, A. E. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza; No. 5, 41-5(Sep-Oct 1970). (In Russian).

Flow of an incompressible, electrically conducting fluid in a duct with a constant rectangular cross section is examined. It is assumed that the walls lying parallel to the y axis are nonconducting, while those parallel to the x axis are ideally conducting; these walls are perpendicular and parallel, respectively, to the direction of the applied magnetic field. With the exception of the pressure, none of the values are assumed to be dependent on the coordinates along the duct; the applied magnetic field was considered to be uniform and the induced current was measured in the external circuit. The correlation between the total current in the external circuit and the potential difference at the conducting walls on one hand, and the external load, the Hartmann number, and the relationships of the lengths of the sides on the other hand, are determined. The algebraic system of linear equations was solved by iteration on a computer. (TTT)

24950 STEADY FLOW OF A CONDUCTING FLUID IN A RECTANGULAR CHANNEL WITH TWO NONCONDUCTING WALLS AND TWO WALLS WITH AN ARBITRARY CONDUCTIVITY, PLACED PARALLEL IN AN EXTERNAL MAGNETIC FIELD. Malov, Yu. I.; Martinson, L. K.; Pavlov, K. B. (Moscow Technical Univ.). Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza; No. 5, 46-52(Sep-Oct 1970). (In Russian).

The flow of a conducting fluid in a rectangular channel is investigated. Two of the walls, lying parallel to the direction of the external magnetic field, possess a certain conductivity; the two other walls are made of an insulating material. The flow problem is solved by using an infinite series. The solution by J. Shercliff on the steady motion of conducting fluids in pipes on the transverse magnetic fields is taken into account. The obtained derivations are used to carry out numerical calculations concerning the velocity distribution and the induced magnetic field across the duct under various flow conditions. Examination of the velocity profile of the conducting fluid in the channel revealed that an increase of the Hartmann number results in a characteristic compression of the profile across the channel. (TTT)

24951 SHOCK WAVES IN RELATIVISTIC MAGNETOHYDRODYNAMICS. Lichnerowicz, Andre (College de France, Paris). Phys. Scr.; 2: 221-5(1970).

A rigorous study of magnetohydrodynamic shock waves is developed. From the compressibility conditions for a relativistic fluid the following are deduced: (1) the time-like character of the magnetohydrodynamic shock waves, (2) the main inequalities between the different speeds and the the thermodynamics of shocks.

and (3) the existence and the uniqueness of a nontrivial solution of the shock equations. (auth) (Sweden)

24952 EFFECTS OF WALL CONDUCTIVITY IN MAGNETOHYDRODYNAMIC DUCT FLOW AT HIGH HARTMANN NUMBERS. Temperley, D. J.; Todd, L. (Univ. of Edinburgh). Proc. Cambridge Phil. Soc.; 69: 337-52(Mar 1971).

Laminar motion of a conducting fluid in a rectangular duct is discussed. The applied magnetic field is uniform and parallel to one pair of sides of the duct. Classical theory is used, and it is shown that the two successive limiting processes, lim ($\sigma_{wall} \to \infty$; $h\sigma_{wall} \to$ a finite, constant limit) and lim ($M \to \infty$) are not always freely interchangeable, M being the Hartmann number, σ_{wall} the electrical conductivity of the duct wall, and h the typical ratio of wall thickness/duct width. A general expansion procedure for $M \gg 1$, valid for all types of wall conductivities, is devised. A critical discussion of the deficiencies in the classical model is given. (auth) (UK)

24953 STEADY MAGNETOHYDRODYNAMIC CHANNEL FLOW WITH ANISOTROPIC CONDUCTIVITY. Panton, D. M., Hosking, R. J. (Flinders Univ. of South Australia, Bedford Park). Aust. J. Phys.; 24: 61-9(1971).

Steady MHD flow through a straight channel of arbitrary cross section with nonconducting walls, in the presence of anisotropic conductivity due to the Hall effect arising from a uniform transverse magnetic field, is considered. No restriction on the Reynolds number nor on the magnetic Reynolds number is made. An approximate solution is provided by a perturbation expansion in terms of the Hall effect parameter, assumed small. Variational principles, constructed for theory up to first order, are used in numerical calculations for the case of a square channel. In addition to the introduction of a secondary cross flow, there is a new asymmetry in the electric current profile and the axial velocity due to the anisotropy, but the mass transport is unchanged. (auth)

Geophysics (Upper Atmosphere)

Refer also to abstracts 23934, 23937, 24934, 25089, and 25272.

24954 (N-70-28819) CONJUGATE PHOTOELECTRON IMPACT IONIZATION. Shawhan, S. D.; Block, L. P.; Falthammar, C. G. (Iowa Univ., Iowa City. Dept. of Physics and Astronomy. Kungliga Tekniska Hogskolan, Stockholm (Sweden)). Mar 1970. 43p. (NASA-CR-110013). NTIS.

The exchange of photoelectrons between ionospheres in a matter of minutes rather than at the slow ambipolar speed is discussed. It is shown that the electron density may be affected by secondary processes resulting from the conjugate photoelectron flux but not by the flux itself. The flux spectrum of conjugate photoelectrons throughout the day at the solstices for minimum solar activity is calculated for 55°N geographic latitude over Europe, using a method previously employed by Nisbet. Compared at specific solar-zenith angles, the computed values are in good agreement with recent satellite measurements. Approximately half of this flux is lost by Coulomb collisions along the field-line path. The resulting flux arriving at the local ionosphere produces ionization by inelastic collisions in the atmosphere. This additional ionization is about 3% of the ionization from local processes at summer noon and 48% at winter noon. During winter nighttime this conjugate photo-electron ionization can be significant for several hours. (auth) (STAR)

24955 (N-70-32498) AURORAL ROCKET EXPERIMENT 2. Final Report. Bernstein, W.; Wax, R. L.; Inouye, G. T. (TRW Systems, Redondo Beach, Calif. Space Sciences Lab.). 15 Jun 1970. Contract NASw-1819. 33p. (NASA-CR-110680; TRW-11228-6008-RO). NTIS.

A flight demonstration of two instruments for the detection of fluxes of energetic neutral hydrogen atoms assumed to exist in the interplanetary medium was conducted. Analysis of the initial flight data indicates a non-Poisson distribution in the time of arrival of hydrogen atoms at the detector, the lateral-spatial extent of the hydrogen forms is less than that calculated earlier for the altitude range at which the observations were made, the dispersion in arrival times of hydrogen atoms of different energies shows that particle acceleration or precipitation control processes act at distances less than 1000 km from the rocket, and the hydrogen precipitation shows a nonisotropic pitch-angle distribution. A second launching into an auroral breakup indicates the presence of millisecond fluctuations in precipitated hydrogen and electron fluxes. (auth) (STAR)

24956 (N-70-42397) BEHAVIOR OF THE IONOSPHERE ABOVE WALLOPS ISLAND DURING THE ECLIPSE OF MARCH 7, 1970. Jackson, J. E.; McQuillan, C. J. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Oct 1970. 27p. (NASA-TM-X-65369; X-625-70-394). NTIS.

The variation of the ionospheric electron density during a solar eclipse was investigated using ionograms. Comparison of the normalized densities at fixed heights to the obscuration function indicates that 7% of the total ionizing flux was of coronal origin and that more flux originated from the eastern half of the Sun than from the western half. The results are consistent with the east-west solar scans of a radio observatory. The normalized densities were also compared to the theoretical prediction made prior to the eclipse. The difference between prediction and observation is due partly to the uniform disk radiation assumed in previous investigation. (auth) (STAR)

24957 (UCRL-Trans-10514) GEOCORONA AND ITS SIGNIFICANCE FOR THE UPPER ATMOSPHERE. Rossbach, Albin. Translated by B. Thayne for Univ. of California Lawrence Radiation Lab., Livermore, from Z. Geophys.; 35: 557-64(1968). 10p. Dep. NTIS.

An abstract of this paper, prepared from the original language, appeared as NSA 24: 17833.

24958 SOLAR-WIND INTERACTION WITH THE FIELD-FREE PLANETS. Michel, F. Curtis (Rice Univ., Houston, Tex.). Comments Astrophys. Space Phys.; 3: 27-31(Jan-Feb 1971).

Three quite dissimilar models have been proposed for the details of the interaction of the solar wind with planetary ionospheres, based respectively on the existence of: (1) restricted flow into the ionosphere (Direct Interaction Model), (2) a solar wind-ionosphere plasma interface (Tangential Discontinuity Model), and (3) an "induced magnetosphere" (Magnetic Barrier Model). These models are briefly discussed. (W.D.M.)

24959 ADDITIONAL IONIZATION SOURCE IN THE IONOSPHERIC E REGION. II. Ivanov-Kholodnyi, G. S.; Korsunova, L. P. Geomagn. Aeron. (USSR) (Engl. Transl.); 10: 578-80 (1970).

Translated from Geomagn. Aeron.; 10: 732-4(1970).

During years of maximum solar activity there is an additional source of ionization in the ionospheric E region. Computations are now studied to see if the ionization function under the effect of solar radiation agrees with electron-density measurements in the E region in low solar-activity years. There is no confirmation yet on the nature of the nighttime ionization source in the ionospheric E region. It is concluded that corpuscular streams not only sustain nighttime ionization, but also create an additional ionization, in the E region during the daytime at a low, high, and medium position of the Sun above the horizon and during low solar-activity years. (J.C.W.)

24960 ROCKET MEASUREMENTS OF THE TEMPERATURE AND WIND IN THE UPPER ATMOSPHERE IN THE POLAR REGION BY THE METHOD OF ARTIFICIAL LUMINOUS CLOUDS. Blamont, J. E.; Chanin, M. L.; Maillard, M.; (and others). Dokl. Akad. Nauk SSSR; 193: 1031-4(11 Aug 1970). (In Russian).

The temperature and the wind velocity in the upper layers of the atmosphere were measured during the fall of 1967 and the spring of 1968 by a joint French-Soviet team at Heiss Island at 80°37' northern latitude using artificial luminous clouds of $NaNO_3$ + Al_2O_3. Six Soviet meteorological, MR-12 type rockets carrying French sodium evaporators have been launched; these evaporators formed thin clouds at altitudes of 120 and 170 km. Diffusion coefficient measurements were also carried out at the same time. Two Soviet instrument packages were launched as part of the experimental series to create dense sodium clouds and to measure the temperature at an altitude of 160 km. The measurements were carried out by means of an electrophotometer on the ground, on the basis of the Doppler broadening of the resonance radiation of the D line of sodium. The results revealed that the temperature of the thermosphere varies widely with the season and as a function of solar and geophysical activity. (TTT)

24961 ELECTRON PRECIPITATION AT LOW ALTITUDES. Kuznetsov, S. N.; Makhmudov, B. M.; Savenko, I. A. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 11: 647-52(Nov-Dec 1970). (In Russian).

Capture of particles with energies exceeding 60 and 300 keV was studied at 200 to 260 km using Kosmos-228 at 51° dip to the equatorial plane. Large fluxes of quasi-captured and precipitated particles during the night in the southern hemisphere and during the day in the northern hemisphere were measured. Data obtained were used for constructing the longitudinal and altitudinal motion

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of particles in the L range of 1.1 to 3.5. The angular dependences of particles with energy E > 60 keV for L = 1.1, 1.3, 1.8, and 3.5 were found. The process of particle precipitation during the night was analyzed. Experimental data obtained were correlated with the theoretical. (tr-auth)

24962 STUDY OF Pc1 PROPAGATION IN THE PRESENCE OF IONIZATION GRADIENTS ALIGNED WITH THE EARTH'S MAGNETIC FIELD. Glangeaud, Francois; Lacoume, Jean-Louis (Paris Univ.). Compt. Rend., Ser. B; 272: 397-400(8 Feb 1971). (In French).

The presence of ionization gradients aligned with the Earth's magnetic field enables the propagation of Pc1 between conjugate points to be explained and allows ground observations to be interpreted. (auth) (France)

24963 SOLAR WIND PROPERTIES AND THE STATE OF THE MAGNETOSPHERE. Hundhausen, A. J. (Los Alamos Scientific Lab., N. Mex.). Ann. Geophys.; 26: 427-42(1970). (LA-DC-10577; CONF-690941-2).

From IAGA General Scientific Assembly, Madrid, Spain.

This review stresses correlations that have been established between numerous solar wind properties and geomagnetic activity. In attempting to understand the physical implications of the correlations, specific patterns of change in the solar wind are identified, and the detailed geomagnetic response is examined. The relationship between interplanetary discontinuities, shock waves, flare-associated disturbances, and the sequence of geomagnetic activity making up a geomagnetic storm is discussed in some detail. In general, the influence of the solar wind on magnetospheric properties related to the gross size and shape of the geomagnetic cavity (or currents at the magnetopause) is fairly well understood; the influence of the solar wind on magnetospheric properties related to internal current or plasma motion is, in contrast, quite poorly understood. 54 references. (auth)

24964 BALLOON MEASUREMENTS OF BREMSSTRAHLUNG X RAYS FROM ELECTRON PRECIPITATION EVENTS IN THE AURORAL ZONE. Trefall, Harald (Univ. of Bergen). SPARMO Bull.; 4: 185-219(Nov 1970).

A review is given of some recent and partly unpublished results on the morphology, dynamics, and time-variations of auroral-zone electron precipitation events, based upon balloon measurements of bremsstrahlung x-rays, carried out by member groups of SPARMO and cooperating groups. The data were obtained during coordinated balloon flights in northern Scandinavia and a few simultaneous flights over Iceland, and in a conjugate-point experiment between Iceland and Antarctica. Special emphasis is given to the local-time dependence and the morphology and dynamics of x-ray events. It is possible to distinguish between impulsive pre-midnight events, bay-associated midnight events, early morning events, late morning events, and noontime events, which typically differ considerably, both in their temporal and spatial features. (auth)

24965 AURORAL-ZONE X-RAY MEASUREMENTS IN FINLAND IN SUMMER 1968. Kangas, J. (Univ. of Oulu, Finland); Tanskanen, P. J.; Legrand, J. P. SPARMO Bull.; 4: 221-8(Nov 1970). (In French).

X-ray measurements made during balloon flights launched from Sodankylä in 1968 are reported, and some comments are given. X-ray measurements are compared with riometer recordings made simultaneously. (France)

24966 RESULTS OF BALLOON FLIGHTS TO MEASURE AURORAL-ZONE X RAYS FROM KIRUNA, SWEDEN IN 1969. Specht, H. (Max-Planck-Institut fuer Aeronomie, Lindau, Ger.); Saeger, K. H.; Richter, K.; (and others). SPARMO Bull.; 4: 229-70(Nov 1970).

The 1969 balloon program consisted of three parts. Part 1 (from June until August) was organized to measure solar protons and auroral-zone x rays. Part 2 (carried out in September) concerned x-ray measurements and auroral emissions, and part 3 (carried out in October) concerned x-ray measurements in connection with an ESRO rocket program (C 62) for measuring electrons and protons during a slowly varying ionospheric absorption event (SVA). Parts 1 and 2 were performed as part of a cooperative program with the Kiruna and Lindau groups. The Meudon group assisted this cooperation in part 3. (auth) (France)

24967 EFFECTS OF CORPUSCULAR FLUXES IN THE NIGHT IONOSPHERE DURING GEOMAGNETIC STORMS IN THE QUIET SUN PERIOD. Velinov, Pet'r; Nestorov, Georgi; Pashova, Tsvetana. Izv. Geofiz. Inst., Bulg. Akad. Nauk; 16: 75-89(1970). (In Russian).

The state of the night E layer during geomagnetic storms is considered. The reflection coefficient at a frequency of 593 kHz under quiet nocturnal conditions is shown. The investigations were made using an absorption measurement at 593 kHz (path Pleven–Sofia, 140 km) and 155 kHz (path Brashov–Sofia, 370 km) at a geomagnetic latitude ~42°. The method of investigation is the oblique sounding of the ionosphere. Anomalous behavior of the night E layer was studied in the period 1964–1966. The conclusions of the analysis are: 1. In the main phase of the ionospheric disturbance an additional ionization in the nocturnal E layer causing a significant absorption at a frequency 593 kHz is observed. 2. After normalizing the ionosphere, a second maximum in the absorption occurs. The additional ionization appears as a consequence of precipitating corpuscular fluxes. 3. The average height to which the particles come is 90 to 95 km, and the maximum of the particle flux is at a height 100 to 120 km. 4. The calculated average flux of ionizing electrons for the additional absorption is in accordance with estimations from rocket measurements under night conditions and at middle latitudes. (TSS) (tr-auth)

24968 CONTRIBUTION OF SOLAR ELECTROMAGNETIC AND PARTICLE RADIATION IN THE IONIZATION OF THE NIGHT E REGION OF THE IONOSPHERE. Nestorov, Georgi. Izv. Geofiz. Inst., Bulg. Akad. Nauk; 16: 67-73(1970). (In Russian).

Through measurement of the ionospheric absorption at an intermediate frequency (~0.5 MHz) in the period of an almost full cycle of solar activity (1959–1968), an approximation is found that well describes the time course of the night absorption in the E region at middle latitudes. The general absorption is a sum of five components: the first one reflects the action of constantly acting ionization sources in the night (galactic x radiation, meteoritic activity, etc.); the second one is due to absorption in a cosmic layer with a maximal electron concentration at a minimal solar activity and vice versa; the third one is a result of the action of the solar sources of electromagnetic radiation during the day (remaining ionization of the daytime E layer in consequence of the limited recombination velocity, airglow, etc.); the fourth and the fifth ones are the contributions of the solar-particle fluxes under disturbances and quiet conditions. It appears that the basic source of ionization in the night in the lower thermosphere responsible for the variations in the solar activity cycle is the particle radiation. The latter should be taken into account as an incessantly acting factor in considering the processes in the high atmosphere. Second in importance are the continuously acting ionizing sources (the galactic x radiation, etc.); the solar electromagnetic radiation and cosmic rays contribute least in the night ionization. The fact that a significant continuously acting ionizing component is observed at night is explained by the availability of night sources of ionization, as well as by an important velocity of the photodetachment; this process can be co-measurable with other processes of direct ionization. (tr-auth)

24969 PROTON AND ELECTRON VEHICULAR ENVIRONMENT. Bourrieau, Jacques (ONERA, Toulouse). Sci. Ind. Spatiales; 6: No. 31, 15-25(1970). (In French).

An attempt is made to define the doses within the more- or less-massive structures of a satellite when considering the space proton and electron environment characteristics. Following a brief review of the chief processes that occur with the slowing down of nuclear particles, diffusion, bremsstrahlung, and nuclear reactions, the two methods of calculation utilized are described. These are linear propagation for the protons, and the theory of multiple diffusion and the Monte Carlo method with reference to the electrons. As examples, the flux transmitted by the walls of a cylindrical satellite and the doses absorbed by coatings are discussed. The chief types of particle detectors with a space application are reviewed, with comments on their modes of functioning and their main characteristics. (IAA)

24970 MODELS OF TEMPERATE-LATITUDE SPORADIC E. Chen, Wen Ming. Logan, Utah; Utah State Univ. (1970). 115p. University Microfilms Order No. 70-26,964.

Thesis.

A general three-dimensional wind-shear theory for the formation of temperate-latitude sporadic E, E_s, was derived. Numerical time-dependent solutions for both one and two positive-ion species with sinusoidal winds and height-dependent kinetic collision frequencies are compared with other sporadic-E calculations to verify the model and method of calculation. A two-dimensional wind-shear model was formulated to investigate causes of tilts in sporadic E-type ion layers and to examine small-scale irregularities in E_s due to meteor-trail ionization. A nighttime E-region model, based on the production due to scattered Lyman-α and Lyman-β radiation, was combined with measured winds to produce a theoretical sporadic-E layer. Comparison of this model with the measured E_s layer showed excellent agreement and con-

firmed the importance of a night-time E-region ion source and the necessity for a complete ion-chemical reaction set. (Diss. Abstr. Int., B)

24971 AURORAL ZONE ELECTRIC FIELD MEASUREMENTS ON SOUNDING ROCKETS. Kelley, Michael Charles. Berkeley, Calif.; Univ. of California (1970). 170p. University Microfilms Order No. 71-800.

Thesis.

Dipole electric-field detectors were flown on three sounding rockets into the auroral-zone ionosphere to measure quasi-static dc electric fields and ac electric fields at frequencies up to 1 kHz. The detector is described and its operation in the ionospheric plasma is discussed in detail. DC electric fields of magnitude 10 to 60 mV/m were detected in the nighttime aurorally excited ionosphere with a significant component of the field parallel to the Earth's magnetic field. During the daytime flight there was no parallel electric-field component and the total field strength ranged from 1 to 8 mV/m. Evidence of detection of electrostatic waves associated with auroral arcs is presented and plots made the ac electric-field spectrum detectable during the three flights. These and other results are discussed in relation to the physics of the auroral-zone ionospheric plasma. (Diss. Abstr. Int., B)

24972 STUDY OF THE LOW-ENERGY ELECTRON COMPONENT OF COSMIC RADIATION. Beedle, Richard Ernest Jr. Minneapolis; Univ. of Minnesota (1970). 106p. University Microfilms Order No. 70-27,184.

Thesis.

A telescope designed to measure the electron and positron intensities in the range 1.6 to 36.4 MeV was flown at Fort Churchill, Canada on July 11, 1969. Positrons are distinguished from electrons by detecting their .511-MeV annihilation photons in the sodium iodide element. The ground-electron intensity and its zenith-angle dependence were measured. The derivation of the electron intensity from the pulse-height information is described. The electron and positron energy spectra measured at 2.4 g/cm^2 atmospheric depth during nighttime conditions is given. The nighttime electron intensity is believed to consist of atmospheric secondaries and extraterrestrial electrons. A correction for the atmospheric secondary intensity at 2.4 g/cm^2 allows a determination of the extraterrestrial electron intensity in the range 7.6 to 43.9 MeV. The extraterrestrial electron intensity derived from the intensity measured at 2.4 g/cm^2 is in good agreement with the intensities measured in 1967 and 1968 below 30 MeV. Between 30 and 43.9 MeV, the present intensity is slightly higher than the previously measured values. The Mount Washington neutron monitor reading for the present measurement was ~7% lower than that for the 1968 measurement and ~9% lower than that for the 1967 measurement. (TSS) (Diss. Abstr. Int., B)

24973 CHARACTERISTICS OF INTRUDING PLASMA IN A SIMULATED MAGNETOSPHERE. Kawashima, Nobuki (Tokyo Univ.). Cosmic Electrodyn.; 1: 415-27(Feb 1971).

Results of a laboratory experiment on the intrusion of plasma in a simulated magnetosphere behind a model Earth are compared with recent satellite observations. The intruding plasma in a simulated magnetosphere seems to correspond to the plasma sheet found behind the Earth in the magnetosphere. Both the laboratory experiment and satellite observations show the dawn–dusk (local time) asymmetry of the plasma distribution in the equatorial plane, the density being much higher on the dawn side than on the dusk side. The enhancement of the intruding plasma in the simulated magnetosphere is observed when the southward external magnetic field is applied. This is related to the recent results of the correlation between the southward interplanetary magnetic field and the higher geomagnetic activities. The effect of an external magnetic field parallel to the plasma stream and the position of the intruding plasma are also discussed in connection with the north–south asymmetry of geomagnetic activities and the position of plasma and neutral sheets. (auth)

24974 SIMPLIFIED MODEL OF THE GEOMAGNETIC S_q CURRENT SYSTEM AND THE ELECTRIC FIELDS WITHIN THE IONOSPHERE. Volland, H. (Univ., Bonn.). Cosmic Electrosyn.; 1: 428-59(Feb 1971).

Very simple exact analytical solutions for the diurnal horizontal winds are derived from the equations of conservation of horizontal momentum including the Coriolis force. The symmetric component of these winds, valid during the equinox, is similar in shape as the winds of the tidal (1, –1) mode. The antisymmetric component is an additional wind field during the solstices. From these winds, equivalently simple analytical formula for the diurnally varying electrostatic potential fields at ionospheric heights are determined with help of the dynamo equations. Assuming an anisotropic and inhomogeneous electric conductivity of the ionosphere developed into a series of spherical harmonics, and adopting the above-mentioned winds and electric fields but abandoning the condition of a divergent free horizontal electric current, simple analytical solutions for the horizontal intensity H and the declination D of the geomagnetic Sq variation that have the form of a Fourier series are determined. These solutions are compared with a data analysis by Matsushita (1967). It follows from this model that the semidiurnal component and the 8-hr period of the geomagnetic Sq variations are mainly generated by a nonlinear coupling between the diurnal winds and the diurnal and semidiurnal components of the ionospheric electric conductivity. (auth)

24975 PLASMA FLOW IN THE MAGNETOSPHERE. I. A TWO-DIMENSIONAL MODEL OF STATIONARY FLOW. Karlson, Erik T. (Royal Inst. of Tech., Stockholm). Cosmic Electrodyn.; 1: 474-95(Feb 1971).

The problem of plasma flow in the magnetosphere is studied with a two-dimensional model of the stationary flow. In an inhomogeneous magnetic field, forbidden regions exist for particles with nonzero energy. The forbidden regions are different for particles of different energies, and they might also be different for ions and electrons. Also, the inertia drift is different for ions and electrons, and gives rise to space charges. It is stressed here that as a result of this, it is necessary to use a self-consistent electric field, i.e., the space charges created by the motion should give the electric field causing the motion. For a distribution of particle energies, this leads to a very difficult problem. The distribution is simulated by two groups of particles with different energies. The space charges due to the inertia drift, and those due to the different forbidden regions are both taken into account in a self-consistent way. It is shown that if the two groups are taken to represent a Maxwellian distribution of particle energies in the plasma sheet, the forbidden regions will be very close to each other. It is pointed out that there is a continuous transport of plasma of terrestrial origin to the tail. If it is assumed that this low-energy (eV) plasma is mixed with the higher-energy (keV) plasma brought in by the solar wind, it becomes possible to identify the forbidden region for the high-energy plasma with the inner edge of the plasma sheet, and the forbidden region for the low-energy plasma with the plasmapause. The electric field in the plasma trough will then be much weaker than the field in the plasma sheet. (auth)

24976 PIONEER 9 ELECTRIC FIELD EXPERIMENT. PART I. NEAR-EARTH OBSERVATIONS. Scarf, F. L.; Green, I. M.; Crook, G. M. (TRW Systems Group, Redondo Beach, Calif.). Cosmic Electrodyn.; 1: 496-512(Feb 1971).

The Pioneer 9 electric-field experiment is described and the near-Earth observations are discussed. It is shown that in the region of the magnetopause the OGO-5 plasma wave experiment and the Pioneer 9 electric-field experiment detected very similar changes in the noise spectrum and these variations may be related to the presence of a diffusive plasma layer. Large and intermittent signal enhancements were also found in the outer magnetosheath and these are shown to be associated with traversals of current sheets resembling X-type nulls. (auth)

24977 PERIODIC ENERGIZATION OF ELECTRONS DUE TO ELECTROMAGNETIC WAVES PROPAGATING THROUGH MAGNETOPLASMA. I. Nath, Omkar; Singh, R. N. (Banaras Hindu Univ., India). Int. J. Electron.; 30: 149-60(Feb 1971).

Interaction of streaming electrons and low-frequency electromagnetic waves, both confined to a geomagnetic tube of force, was studied. Following Roberts and Buchsbaum's theory, it is shown that electron energy gain is oscillatory. Considering low-energy (<10 eV) electrons, the time period of energy oscillation is found to be maximum at the equator for $\omega \leq 15$ kHz and increases with increasing frequency. For $15 \leq \omega \leq 100$ kHz, the maximum time period of energy oscillation is found to be almost constant (5.3×10^{-2} sec) in the entire band of frequencies. The maximum time period shifts towards higher latitude with increasing frequencies, whereas, for high-energy (100 keV) electrons, the time period of energy oscillation increases with the increasing latitude, and at high latitude (65°), the time period is almost constant (0.98×10^{-2} sec) for waves of different frequencies. The energy gain is found to increase steadily with increasing latitude. Observed periodic geophysical phenomena are interpreted in terms of calculated results and their significance is discussed. (auth) (UK)

24978 METHOD FOR PREDICTING THE F1-LAYER CRITICAL FREQUENCY. DuCharme, E. D. (Communications Research Centre, Ottawa); Petrie, L. E.; Eyfrig, R. Radio Sci.; 6: 369-77(Mar 1971).

The development of a method for predicting monthly median values of the F1-layer penetration frequency (f_0F_1) at any location and time is described. The expressions derived for predicting the monthly median f_0F_1 are functions of the zenith angle of the Sun, the ionospheric index IF_2, and the geomagnetic latitude. (auth)

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24979 DISTURBANCE OF THE GEOMAGNETIC FIELD DURING 1960–1967 ACCORDING TO OBSERVATIONS OF THE MAGNETIC OBSERVATORY PLESHCHENITSY (MINSK). Babushnikov, M. S. (Geophysical Station, Minsk). Dokl. Akad. Nauk BSSR; 14: 705-8(Aug 1970). (In Russian).

The dynamical motion of the disturbance of the geomagnetic field in relation to the 11-year solar cycle is discussed. Minimum geomagnetic activity during the solar cycle turned out to be a year later than in minimum solar activity. There is noted a significant decrease of geomagnetic activity during the increase of number of sunspots in comparison with the same number during the 11-year cycle. It was found that maximum magnetic activity does not always happen in the period of equinoxes, but in each year it was during different months and, instead of two maxima during the year, it often happened in one month. In the average annual magnitudes of the magnetic activity and the numbers of the solar spots there is an observed relationship, but taken yearly, the relationship is almost lost. (tr-auth)

24980 QUASI-RADIAL HYPERVELOCITY APPROXIMATION OF THE AZIMUTHALLY DEPENDENT SOLAR WIND. Sakurai, Takeo (Kyoto Univ.). Cosmic Electrodyn.; 1: 460-73(Feb 1971).

A simple method of approximation of the basic equations of the rotating azimuthally dependent solar wind under the effect of the magnetic field is proposed and applied to the model profile of the solar-wind properties. The results give 8 km/sec mean-azimuthal velocity near the orbit of the Earth, comparing favorably with Siscoe et al.'s mechanism that the slow radial stream is pushed westwards by the interaction of the fast and slow radial streams and with Brandt's observation that the mean azimuthal velocity increases with the increase of the magnetic activity in the solar wind. (auth)

24981 POSITIVELY BIASED IONOSPHERIC PROBES. Fournier, G. (Onera, Chatillon, France). Phys. Lett.; 34A: 241-2 (8 Mar 1971).

An assumption is made that a positive probe immersed in a flowing plasma does not produce a sheath, and that the applied potential extends to infinity. If a steady state exists for the probe in the flowing plasma, the method permits the computation of the potential and density distributions around the probe. The complexity of the method is increased when the probe is satellite-borne. An exact prediction of Sayers-probe results should involve an exhaustive analysis of the electron-density distribution around the probe wires. (J.C.W.)

24982 COMPLEX RAY THEORY FOR ION CYCLOTRON WHISTLERS. Terry, P. D. (Cambridge Univ., Eng.). Nature (London) Phys. Sci.; 229: 200-2(15 Feb 1971).

The shape of the curve representing the real part of the refractive index for upgoing electromagnetic waves as a function of real height at a fixed frequency for a plasma containing more than one kind of positive ion assumes one of two forms depending on the angle ψ between the wave normal and the Earth's magnetic field. When this angle equals a critical value ψ_c, both the left- and right-handed modes have linear polarization at a certain height called the crossover height. Near this level and for a small cone of angles near ψ_c mode conversion is possible, and results are given of a study of this phenomena by ray tracing. (UK)

24983 SURFACE RADIATION BALANCE MEASUREMENTS IN INDIA DURING THE IQSY. Chacko, O.; Thomas, C. T.; Mani, A. Indian J. Meteorol. Geophys.; 19: No. 1, 93-8(1968).

Results of surface radiation-balance measurements at Poona, Calcutta, and Delhi during the IQSY are presented. The diurnal, seasonal, and spatial variations of net radiation are discussed, with reference to solar elevation, cloudiness, albedo, and surface moisture and temperature. Net radiation during the day is maximum during the clear summer months and least during cloudy monsoon and winter months. At night net radiation is negative and generally very small or zero. Marked differences are present in the magnitude and the distribution of net radiation at Poona, Calcutta, and Delhi. (Indian Sci. Abstr.)

24984 REPORT ON THE RESULTS OF THE BALLOON LAUNCHING CAMPAIGN WHICH TOOK PLACE IN ICELAND BETWEEN SEPTEMBER 1 AND OCTOBER 15, 1968. PART 2. PRELIMINARY REPORT ON THE MEASUREMENTS OF SOLAR PARTICLES DURING THE EVENT OF SEPTEMBER 29, 1968. Heristchi, Dj.; Legrand, J. P.; Petrou, D. (Observatoire de Paris, Meudon, France). SPARMO Bull.; 4: No. 1-2, 75-87 (Mar 1970). (In French).

Measurements of the solar x rays and protons associated with the solar flare of September 29, 1968 at 16.20 UT are reported. The measurements were obtained using balloon-borne detectors, launched from Iceland. The first of a series of three balloons carried a scintillation counter of the type SPARMO SC 67; the two other balloons carried multidirectional detectors. The x-ray event occurred at 16.20 UT. It was well correlated with the solar radio emissions. The energy spectrum of the x-ray flux softened during the event. The proton event started at 16.50 UT; it must have reached its maximum between 18 and 22 UT and lasted until after 20 UT of the following day. The energy spectrum of the proton flux was characterized by $\gamma = 3.5$, when approximated by a power law of the form $dJ \sim E^{-\gamma} dE$. The intensity-versus-time profile was compared with the two diffusion models of KRIMIGIS and BURLAGA. (France)

24985 EFFECTS OF THE AURORAL ELECTRON PRECIPITATIONS ON THE LOWER IONOSPHERE DURING THE SUBSTORMS ON THE 24th AND 30th OF MARCH 1968. Benkova, N. (IZMIRAN, Moscow); Boukin, G.; Taieb, C.; Walter, J. Ann. Geophys.; 26: 671-4(Jul-Sep 1970). (In French).

The effects on the low ionosphere (regions E and D) of the two substorms of March 20 and 24, 1968 were investigated at two magnetically conjugate stations. Simultaneous balloon measurements of x radiation generated by electrons precipitated in the auroral zone indicated that ionospheric data may be used to evaluate the energy spectra of precipitated electrons. (auth) (France)

24986 LOCAL TIME DEPENDENCE OF AURORAL ZONE ELECTRON SPECTRA. Kuck, George A. (Air Force Cambridge Research Labs., Bedford, Mass.). Ann. Geophys.; 26: 689-95(Jul-Sep 1970).

The energy spectra from 10 to 100 keV of quasi-trapped and precipitating electrons were measured by a polar-orbiting satellite. Spectral parameters were obtained for 15 electron events. These events indicate that the electron spectra are softer before local midnight than after local midnight. More events were seen at higher K_p than lower K_p, indicating that the intensity of the events depended upon K_p. The satellite results were in qualitative agreement with balloon measurements of x-rays caused by precipitating particles. (auth) (France)

24987 OBSERVATION OF A LOW-ALTITUDE AURORA. Nguyen-Huu-Doan (Observatoire de Lyon, Saint-Genis-Laval, France. CNRS, Marseille). Ann. Geophys.; 26: 783-9(Jul-Sep 1970). (In French).

A low-latitude aurora was observed at the Haute Provence Observatory (latitude 43°56′) during the night 8/9th of March 1970. In its spectrum very intense bands and lines corresponding to N_2^+, O I, O II, and N I, were observed. Although the violet helium line was present, lines corresponding to the hydrogen Balmer series were absent. The nonintensified lines present were the Na I yellow and the O I green. It is believed that the low-altitude aurora occupies very high regions in the atmosphere 250 to 1000 km where excitation is caused by collisions between electrons and the atoms and molecules present. At dawn this sunlit aurora exhibited extraordinary intensity enhancement in its N_2^+ bands, this time, due to optical resonance. (auth)

24988 ON THE POSSIBILITY OF SOUNDING OF THE INTERPLANETARY SHOCK WAVES AND FORECASTING OF THE GEOMAGNETIC STORMS ON THE BASIS OF THE GROUND OBSERVATIONS OF COSMIC RAYS. Dorman, L. I.; Kaminer, N. S. (IZMIRAN, Moscow). Ann. Geophys.; 26: 697-701(Jul-Sep 1970).

It is shown that a small increase in intensity occurs when cosmic rays are reflected from the shock wave propagated by the Sun before a geomagnetic storm. Analysis of ground data on cosmic radiation over a period of twenty years has revealed the principal characteristics of this augmentation phenomenon. Good agreement between the observed and the predicted characteristics indicates that accurate simultaneous observation of cosmic-ray intensities at many stations yields continuous information on the powerful shock waves propagated in interplanetary space and gives short-term forecasts on geomagnetic storms. (auth) (France)

24989 METASTABLE OXYGEN IONS DISTRIBUTION AND RELATED OPTICAL EMISSION IN THE AURORA. Gerard, J.-C. (Liege Univ.). Ann. Geophys.; 26: 777-81(Jul-Sep 1970).

The importance of the metastable species O_2^+ : a $^4\Pi_u$, O^{+2} D^0, and $^2P^0$ and their related line intensities are discussed. The results are illustrated for a typical IBC II aurora for which the 7319−7330 A ($^2D^0-^2P^0$) and 3726−3729 A ($^4S^0-^2D^0$) emission rates are compared. The efficiency of the charge transfer from O^+ ($^2D^0$) to O (^3P) is evaluated for normal auroral conditions and its contribution to the excitation of the λ6300 line is estimated to be less than 1% between the ionization peak and 300 km. (auth) (France)

24990 RELATION OF ELECTRON AND PROTON AURORAL MORPHOLOGY TO GEOMAGNETIC ACTIVITY. Deehr, C. S.; Sten, T. A.; Egeland, A.; Omholt, A. (Norwegian Inst. of Cosmic Physics, Oslo). ELDO/ESRO Sci. Tech. Rev.; 2: 233-46 (1970).

Hydrogen and ionized nitrogen auroral emissions were measured with photometers on board the ESRO-I Satellite. A relatively detailed description of the optical equipment is given. A statistical study of the relation between latitudinal changes in the electron and proton aurorae and gross geomagnetic activity represented by the planetary index, K_p, is presented. It was found that the invariant latitude for the peak intensities of both the hydrogen emission decreased with increasing values of K_p. The preliminary results show that a plateau exists in the curve of the invariant latitude as a function of K_p, for both the electron and proton aurorae. (auth) (France)

24991 STABLE [O I] 6300A ARCS ENCIRCLING MID-LATITUDE REGIONS OF EARTH. Hoch, Richmond Joel, Seattle; Univ. of Washington (1970). 230p. University Microfilms Order No. 71-977.

A brief history of research on Stable Auroral Red (SAR) arcs is presented. Results of observations of SAR-arcs from Richland, Washington, during the period September 27, 1967, through March 31, 1970, are described. The ratio of [O I] 6300 A/[O I] 5577 A was determined in one intense SAR arc (3.5 to 4 kR) to be 26. An analysis of the process of excitation of atomic oxygen by electrons shows that the observed arc would be produced by electrons with a characteristic temperature of 4200°K and lower than normally assumed density. In addition, a very small high-energy tail on a Maxwellian distribution of electron energies is required. The possibility of the SAR arcs being excited by the magnetospheric particles that cause the main-phase decrease of the geomagnetic field is investigated. Evidence of the spatial and temporal coincidence of intermediate-energy magnetospheric particles with the SAR arcs is found and reviewed. The energy content and loss-rate measured are found to fit the requirements of SAR-arc production. The excitation of the SAR arcs is examined in terms of the behavior of the incoming charged particles and secondaries traversing the atmosphere. The physical conditions at the interface of the plasmasphere and the source region of the SAR arcs are examined, and it is found that it is plausible that a suprathermal electron distribution should be formed at the interface. A simple model of the magnetosphere is formulated, and an analysis of the plasmapause is undertaken. It is found that the plasmapause is an unstable region. In this region, longitudinal (hm) waves can develop and propagate freely. Wave energy is dissipated preferentially at the boundary. This localization of heating might, it is suggested, give rise to the distribution of particles that cause the main-phase field decrease and excite the SAR arcs. (TSS) (Diss. Abstr. Int., B)

24992 OBSERVATION OF D-ZONE PROPAGATION DURING SOLAR ECLIPSE. Lombardini, P. P.; Showers, R. M.; Angell, V. C. (Univ. of Pennsylvania, Philadelphia). Proc. IEEE (Inst. Elec. Electron. Eng.); 59: 302-4(Feb 1971).

Observed variations in D-region propagation effects showed strong correlation with the occurrence of the solar eclipse of March 7, 1970. Atmospheric noise in the lf range received from the general direction of the equator recorded the variation in output noise at Valley Forge, Pa. It is seen that the increase in the noise level corresponds very closely with the time of the occultation in this general area. (J.C.W.)

24993 CONSTRUCTION AND USE OF A SIMPLE IONOSPHERIC MODEL. Nisbet, J. S. (Pennsylvania State Univ., University Park). Radio Sci.; 6: 437-64(Apr 1971).

The parameters controlling the development of a simple model of the E and F regions of the ionosphere are discussed. A computer model is described that will provide estimates of the electron and ion densities in middle latitudes as a function of latitude, longitude, altitude, season, time, and solar activity. Statistical parameters for mid-latitude blanketing sporadic E are presented. An analytic expression is used for the CIRA 1965 neutral atmospheric models. The F1 region is treated using a photoequilibrium model with three ionic constituents and 62 ionizing radiation groups. The F_2 layer uses theoretical models arranged to fit boundary conditions of N_mF_2, H_mF_2, and the electron density at 1000 km. Values of N_mF_2 are obtained by using the CCIR atlas of ionospheric characteristics. The mid-latitude sporadic-E layer is treated by presenting three parameters of the layer: the probability of observing sporadic E with a blanketing frequency greater than 0.5 MHz, the average peak electron density when sporadic E is observed, and the standard deviation (assuming log normal distributions for the peak electron density). (auth)

24994 RECIPROCITY THEOREM FOR MAGNETOIONIC MODES. Altman, C.; Postan, A. (Technion-Israel Inst. of Tech., Haifa). Radio Sci.; 6: 483-7(Apr 1971).

An arbitrary plane slab is considered within a magnetoplasma whose parameters vary in a direction perpendicular to the (horizontal) plane of stratification, the plane of the slab faces; 2×2 reflection and transmission coefficient matrices are defined for the slab in terms of up-going waves incident from below, R_u and T_u, and in terms of downgoing waves incident from above, R_D and T_D. The matrix elements compare amplitudes of the wave fields of the characteristic magnetoionic modes, so normalized that in regions of negligible absorption the squares of the amplitudes are proportional to the mean Poynting vector. The theorem that is proved states that the matrix T_u is the transpose of the matrix T_D and that the matrices R_u and R_D are symmetric. Some applications are discussed. (auth)

24995 NONLINEAR LONGITUDINAL WAVES IN A HOT, COLLISIONAL MAGNETOPLASMA WITH APPLICATIONS TO IONOSPHERIC IRREGULARITIES. Sen, Hari K.; Dubs, Charles W.; Prasad, Balram (Air Force Cambridge Research Labs., Bedford, Mass.). Radio Sci.; 6: 489-94(Apr 1971).

Nonlinear differential equations are derived for a plane, longitudinal steady-state wave propagating perpendicularly to a magnetic field in a thermal, collisional, weakly ionized plasma in the two-fluid approximation. They describe the variation along the propagation direction of the longitudinal electric field and the two components of velocity of each species. In the limit of small amplitude of oscillation, the equations lead to the dispersion relation obtained by Kato and Hirata (1967). Numerical solutions for various possible values of parameters in the ionospheric E layer are obtained with a computer. When the electron-jet velocity is larger than the ion thermal velocity, primarily ion waves of a few tens of kHz frequency and a few cm wavelength are obtained. The amplitude of the waves has a maximum value and it decays in the laboratory frame with an e-folding distance of a fraction of a meter. Radar-backscatter observations (with metric wavelengths) seem to be from the envelope of the wave. The electric field of the maximum amplitude is 1–2 V/m, which is $\sim 10^5$ times the microfield energy density and a few per cent of the kinetic energy density of the ion motion relative to the wave. It increases with wave velocity but not with electron-jet velocity. (auth)

24996 TRANSIENT PROPAGATION OF ELECTROMAGNETIC WAVES IN A STRATIFIED PLASMA. Field, John C. (Univ. of Maine, Orono). Radio Sci.; 6: 503-10(Apr 1971).

The method of characteristics is applied to the study of transient electromagnetic-wave propagation in a stratified plasma. The technique is applicable to lossy, anisotropic, time-varying plasmas whose parameters may vary in the direction of wave propagation. Numerical results demonstrate good agreement with theory. (auth)

24997 ATMOSPHERIC NOISE MEASUREMENTS AT MAUNA KEA OBSERVATORY AND LOS ALAMOS. Beery, J. G.; Shipley, J. P. (Los Alamos Scientific Lab., N. Mex.). Nature (London) Phys. Sci.; 229: 236-7(22 Feb 1971).

Measurements were made and are reported of atmospheric noise with the same radiometer on 9,370 MHz at Los Alamos, New Mexico, at an altitude of 7,300 feet, during the period August 1968 to July 1969, and from November 1969 to August 1970 at Mauna Kea Observatory in Hawaii at an altitude of 13,800 feet. The noise at Los Alamos seemed usually less than that at Mauna Kea. The effect of precipitable water vapour and winds and diurnal variations are discussed. (UK)

24998 NEGATIVE SUDDEN PHASE ANOMALY. Oshio, Mitsuo (Radio Research Labs., Tokyo). Nature (London) Phys. Sci.; 229: 239-40(22 Feb 1971).

When the flux from a soft x-ray flare on the Sun is sufficient to ionize the neutral constituents of the Earth's atmosphere at the level where very low frequency (vlf) radio waves are reflected, no sudden phase anomaly is observed on vlf propagation circuits that are in the sunlit hemisphere of the Earth, or are in a daytime condition, even though part of the circuit is in darkness. The existence of "negative SPAs," i.e., when these conditions are strongly developed, were predicted and have now been observed (Ishii et al., 1969). The phenomena are discussed, and it is concluded that negative SPAs occur when there is a small-scale enhancement of the intensity of the solar x-ray flux (at one to a few Angströms) and a large representative solar zenith angle for a propagation circuit situated at relatively high latitudes. This would be consistent with the predictions of the conditions for the occurrence of the negative SPA phenomenon. (UK)

XUM

24999 SOLAR-CYCLE VARIATIONS OF f_0F_2 and h_pF_2 AT LOW LATITUDES. Rastogi, R. G. (Physical Research Lab., Ahmedabad, India). Nature (London) Phys. Sci.; 229: 240-2(22 Feb 1971).

The effect of the solar cycle on the daily variation of f_0F_2(the critical frequency of the F_2 layer) and on the height of the maximum ionization, h_pF_2, is described. This height is assumed equal to the virtual heights of reflexion at a frequency 0.834 f_0F_2 at stations in the same longitude zone but near the equatorial trough region (Kodaikanal/Thumba), near the peak f_0F_2 region (Ahmedabad), and beyond the equatorial anomaly region (Kokubunji). The study covers the period 1953–68 for Ahmedabad, 1956–68 for Kodaikanal/Thumba, and 1952–67 for Kokubunji. The average variations of the principle F_2 characteristics at Kodaikanal are very similar to those at Thumba. It is shown that the solar cycle variations of f_0F_2 are greatly affected by the electron-dynamic lifting of the F_2 region, so quantitative studies of f_0F_2 variations at low latitudes should, therefore, preferably be done in conjunction with the corresponding variations in h_pF_2 because the two parameters are so closely interlinked. (UK)

25000 ICN ACOUSTIC WAVE DETECTION USING A CONTINUOUS CHANNEL ELECTRON MULTIPLIER. Rehmann, Wilhelm K.; Stone, Nobie H. (Marshall Space Flight Center, Huntsville, Ala.). Rev. Sci. Instrum.; 42: 529-30(Apr 1971).

A comparison of the use of a continuous-channel electron multiplier and a metal electrode for measuring ion acoustic waves in an ionospheric plasma is given. The advantages of the electron multiplier for low density plasmas are described. (M.O.W.)

Low-Temperature Physics and Cryogenic Equipment

Superfluidity

25001 MUTUAL FRICTION AND THE THERMAL CONDUCTIVITY OF SUPERFLUID HELIUM NEAR T_λ. Leiderer, P.; Pobell, F. (Technische Hochschule, Munich). J. Low Temp. Phys.; 3: 577-88(Dec 1970).

Temperature gradients in superfluid helium carrying a heat current in a 13.8-mm-wide tube or in a 0.1-mm-wide slit were measured at 0.09 m°K < T_λ to T < 16 m°K. The results are interpreted in terms of a mutual friction force between the normal component of He II and vortices in its counterflowing superfluid component. This force is found to diverge near T_λ with a mutual friction constant proportional to $(T_\lambda - T)^{-0.35 \pm 0.06}$. (auth)

25002 SPECIFIC HEAT OF ADSORBED FILMS OF ^{3}He, ^{4}He, AND ISOTOPIC HELIUM MIXTURES NEAR MONOLAYER COVERAGES. Brewer, D. F.; Evenson, A.; Thomson, A. L. (Univ. of Sussex, Brighton, Eng.). J. Low Temp. Phys.; 3: 603-17 (Dec 1970).

Specific heat results are presented for near-monolayer films of ^{3}He, ^{4}He, and isotopic He mixtures adsorbed on Vycor porous glass in the temperature range between 1 and 4°K. In the case of the pure He monolayers and submonolayers, the specific heats depend only on T^2, like a two-dimensional Debye elastic medium. A film of slightly greater than monolayer coverage needs an additional temperature-independent term. Monolayer coverages of mixtures are difficult to define, but all coverages, used, some of which are submonolayer, need both T^2 and T-independent terms. The constant term may arise from atoms in the second layer forming a classical noninteracting system which, in the mixture case, would indicate selective adsorption of ^{4}He in preference to ^{3}He at the substrate wall, in agreement with previous adsorption experiments on the same substrate. (auth)

25003 STRUCTURE OF ADSORBED FILM OF A BOSE LIQUID. Amit, Daniel J. (Stanford Univ., Calif. Brandeis Univ., Waltham, Mass.). J. Low Temp. Phys.; 3: 645-53(Dec 1970).

It is shown that the Hartree approximation, adapted to situations in which the many-body system has a bound ground state, is suitable for obtaining a qualitative description of the structure of an adsorbed He-II film in the presence of an attractive wall potential. (auth)

25004 PHONON DISPERSION IN A LOW-TEMPERATURE WEAKLY INTERACTING BOSE GAS. Ma, Shang-keng (Univ. of California, San Diego, La Jolla); Gould, Harvey; Wong, Victor K. Phys. Rev., A; 3: 1453-62(Apr 1971).

Phonon dispersion in a weakly interacting Bose gas at low temperatures is investigated from a purely microscopic viewpoint. The role of the interaction and the effects of the condensate are emphasized in a generalized dielectric formulation. The leading terms for the frequency and damping rate of phonons are evaluated exactly from the zero of the dielectric constant. These terms may be viewed as the extension of Belyaev's zero-temperature results to low temperatures. (auth)

25005 HELIUM ISOTOPE QUANTUM FLUID MIXTURES. Betts, David S. (Univ. of Sussex, Eng.). Contemp. Phys.; 12: 153-78(Mar 1971).

The last five years have seen a burst of activity leading to the current view that ^{3}He atoms dissolved in superfluid liquid ^{4}He show remarkable resemblance to a weakly interacting Fermi gas. This is because the solvent ^{4}He, having vanishingly small entropy, specific heat, viscosity and magnetic susceptibility, behaves almost as if it were a "massive vacuum", in which ^{3}He atoms float. So at last a real Fermi "gas" is available and can readily be cooled to temperatures well below its Fermi degeneracy temperature. This model of solute ^{3}He, with its weaknesses and strengths, is the basis of this article. (auth) (UK)

25006 TOPICAL ISSUE ON THIN HELIUM FILMS. Symposium Held at Hoboken, N. J., June 4–5, 1970. Daunt, John G. (ed.). J. Low Temp. Phys.; 3: 197-377(Sep 1970). (CONF-700642).

Sixteen papers are included on thin helium films; separate abstracts were prepared for seven. (M.H.R.)

For abstracts of individual papers see: 25007–25013.

25007 UNSATURATED HELIUM FILMS AS QUANTUM FLUIDS. Meyer, Lothar (Univ. of Chicago). J. Low Temp. Phys.; 3: 199-204(Sep 1970).

From Symposium on Thin Helium Films, Hoboken, N. J. See CONF-700642.

Basic information on unsaturated helium films is reviewed. The point is made that inadequate knowledge of the structure and thickness of adsorbed layers is still the weakest link in understanding thin and thick helium films and their behavior. 41 references. (W.H.R.)

25008 SOME THERMAL, MAGNETIC, AND FLOW PROPERTIES OF ADSORBED He AND ^{3}He–^{4}He MIXTURES. Brewer, D. F. (Univ. of Sussex, Eng.). J. Low Temp. Phys.; 3: 205-24(Sep 1970).

From Symposium on Thin Helium Films, Hoboken, N. J. See CONF-700642.

Some of the work relating to the structure and formation of He films, the nature of the monolayer, the modification of the lambda specific heat in ^{4}He films, and the onset of Fermi degeneracy in ^{3}He is summarized briefly. 36 references. (M.H.R.)

25009 THIRD SOUND AND THE SUPERFLUID PARAMETERS OF THIN HELIUM FILMS. Rudnick, I.; Fraser, J. C. (Univ. of California, Los Angeles). J. Low Temp. Phys.; 3: 225-34(Sep 1970).

From Symposium on Thin Helium Films, Hoboken, N. J. See CONF-700642.

Some recent imaginative experiments that use ultra-high frequency acoustic interference phenomena as calipers for film thickness are reviewed. Using a line heater as a source and a deposited aluminum filament operated at its superconducting transition temperature as a temperature sensitive sensor, pulse measurements were made on the velocity of third sound. The results are discussed and compared with theory. (M.H.R.)

25010 THIRD-SOUND RESONANCE AND THERMAL RESISTANCE IN UNSATURATED HELIUM FILMS. Ratnam, B.; Mochel, J. (Univ. of Illinois, Urbana). J. Low Temp. Phys.; 3: 239-46(Sep 1970).

From Symposium on Thin Helium Films, Hoboken, N. J. See CONF-700642.

A thermodynamic state of thin helium films was obtained that permits precision measurements of their properties. Third-sound resonances indicate a transition in the superfluid density of these films. This transition is accompanied by an exponential rise in the thermal resistance of the helium film, which indicates the formation of high-energy excitations of 0.08 eV. The dissipation at resonance indicates that thermodynamic fluctuations are the principal mode of third-sound damping. (auth)

25011 HYDRODYNAMICS AND THIRD SOUND IN THIN SUPERFLUID HELIUM FILMS. Bergman, D. (Tel Aviv Univ., Israel). J. Low Temp. Phys.; 3: 247-8(Sep 1970).

From Symposium on Thin Helium Films, Hoboken, N. J. See CONF-700642.

The linearized hydrodynamic equations for thin superfluid films, which were solved previously by an analytical approximation, were solved numerically to yield the velocity and attenuation of third-sound waves. The point is made that: Atkins theory seems to be inadequate over all the interesting regions and the gas and the substrate must be treated in full hydrodynamic detail in order to get the correct behavior. (M.H.R.)

25012 SUPERFLUID TRANSITION OF A HELIUM FILM ACCORDING TO THE LANDAU–GINZBURG–PITAEVSKII THEORY OF HELIUM II. Dukek, Guenter (Univ., Karlsruhe, Ger.); Stenschke, Herbert. J. Low Temp. Phys.; 3: 249-54 (Sep 1970).

From Symposium on Thin Helium Films, Hoboken, N. J. See CONF-700642.

The superfluid transition of a helium film is discussed in the framework of the phenomenological Landau–Ginzburg–Pitaevskii theory. In order to obtain agreement with experiments, it turns out to be essential to check the film solutions of the Ginzburg–Pitaevskii differential equation for stability. (auth)

25013 COMMENT ON THE PAPER OF G. V. CHESTER ON EXCITATION SPECTRUM AND HYDRODYNAMICS OF UNSATURATED HELIUM FILMS. Halperin, B. I. (Bell Telephone Labs., Murray Hill, N. J.). J. Low Temp. Phys.; 3: 255(Sep 1970).

From Symposium on Thin Helium Films, Hoboken, N. J. See CONF-700642.

A calculation of the superfluid density at 0°K is discussed briefly. It is noted that an essential feature of the calculation is that the translational invariance of the ground-state wave function in the x–y plane is broken by the atomic nature of the substrate and by the first solidified layer of helium. (M.H.R.)

25014 THEORY OF THE SUPERFLUID TRANSITION IN LIQUID HELIUM. Chapline, George Jr. (Univ. of California, Livermore). Phys. Rev., A; 3: 1671-9(May 1971).

A simple method for approximately calculating the effect of Bose statistics on the properties of liquid helium is given. It is shown that as the temperature is lowered, normal helium undergoes a transition to a state in which a finite fraction of the atoms are in a coherent state. Using only the experimental interatomic potential and pair-correlation function, the transition temperature for liquid helium in equilibrium with its vapor is calculated to be 2.15°K. The dependence of the transition temperature on pressure is calculated and found to be in good agreement with experiment. The specific heat is calculated and is found to diverge as the λ temperature is approached. It is also shown that as the temperature is lowered, a density maximum will occur in liquid helium slightly above the λ temperature. (auth)

25015 HEAT CONDUCTION BY HELIUM II CONTAINED IN SMALL CHANNELS. Alcaraz, E. C.; Madden, H. H. (Wayne State Univ., Detroit). Phys. Rev., A; 3: 1698-1703(May 1971).

Helium-II heat-flow experiments were carried out with the helium contained in small channels (tubes < 10 μ in diameter d) having simple geometries and with the temperature differences limited to $\sim 5 \times 10^{-3}$ K° or less. In this domain, the heat current density is found to be proportional to the temperature gradient and the differential thermohydrodynamic equations of London and Zilsel should be valid. Comparison with the London–Zilsel theory shows good agreement for most of the data with regard to the absolute magnitude of the thermal conductivity κ and its dependence on temperature. The experimental κ values have a weaker dependence on the channel size than the theoretically predicted square of d, and this size dependence is a function of temperature. The data for the largest channels ($d \sim 8\mu$) and at the larger heat current densities depart significantly from the London–Zilsel predictions. This difference is not explainable on the basis of a Gorter–Mellink mutual friction, but is consistent with a dissipative flow for the superfluid depending linearly on its velocity. This superfluid dissipative flow is comparable to that reported in other helium-flow experiments. (auth)

25016 QUANTUM EFFECTS IN WEAKLY COUPLED SUPERFLUID LIQUIDS. Leplae, L.; Mancini, F.; Umezawa, H. (Univ. of Winconsin, Milwaukee). Phys. Lett.; 34A: 301-2(5 Apr 1971).

The boson method is applied to the study of two superfluid liquids joined together by a weak link. A microscopic derivation of experimental results is presented. (auth)

25017 CRITICAL VELOCITY MEASUREMENT IN SUPERFLUID HELIUM BY DOPPLER-SHIFTED RESONANCE SPLITTING. Hubert, J. M.; Adair III, T. W.; Naugle, D. G. (Texas A and M Univ., College Station). J. Low Temp. Phys.; 4: 65-71(Jan 1971).

Splitting of fourth-sound resonances was observed in a cylindrical cavity packed with 0.3 μ of alumina powder. The porosity of the powder was 83%. Angular velocities of persistent currents in the superfluid helium filling the cavity were measured up to 13 rad/sec. A critical velocity of 37 ± 7 cm/sec at 1.55°K was determined from these measurements. This result appears to be consistent with current theory and with other experiments. (auth)

25018 KINETIC ENERGIES OF ATOMIC MOTIONS IN LIQUID ^{4}He. Gibbs, Alan G.; Harling, O. K. (Battelle-Northwest, Richland, Wash.). Phys. Rev., A; 3: 1713-17(May 1971).

It is shown that average atomic kinetic energies in liquid helium can be deduced, as a function of temperature, in an elementary fashion, using existing experimental data and an empirical interatomic potential. The resulting kinetic energies are compared to the results of fitting recent high-energy neutron scattering data with the simple model of Puff and Tenn. (auth)

Superconductivity

Refer also to abstracts 23913, 24651, 24658, and 25230.

25019 (ISS–70/1) CRITICAL BEHAVIOR IN THE LINEAR RESPONSE OF A SUPERCONDUCTOR TO A STATIC MAGNETIC FIELD. de Pasquale, F.; Tabet, E. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). 2 Jan 1970. 31p. Dep. NTIS (U. S. Sales Only).

The order-parameter fluctuations are studied in the framework of the microscopic theory of superconductivity, both for $T > T_c$ and for $T < T_c$. The critical behavior of the local superfluid density $\rho_s(k)$ is investigated, and the continuity of ρ_s in the critical region is explicitly shown. Long-range correlations in the order parameter–order parameter correlation function T(q) are found below T_c. The link of the behavior of T(q) with the Goldstone mode induced by the gauge-symmetry breakdown and the role played by long-range correlations in ensuring continuity in the critical region are discussed. Agreement with the phenomenological theory and with some previous results for $T > T_c$ is found. (auth)

25020 (ISS–70/6) MODULATION SPECTROSCOPY OF SURFACE SUPERCONDUCTIVITY OF Pb FILMS. Indovina, P. L.; Onori, S.; Tabet, E. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). 10 Mar 1970. 30p. (In Italian). Dep. NTIS (U. S. Sales Only).

A high-sensitivity differential technique was applied to the investigation of the microwave surface impedance of superconductors. Some measurements of the critical fields H_{c3} (surface critical field) and H_{cF} of Pb films performed by detecting the first derivative dR_S/dH of the real part of the microwave surface impedance as a function of an external magnetic field are presented. It is shown that, in the temperature range 5.42 to 7.22°K, a Pb film exhibits only a first-order phase transition in a magnetic field, whereas for $T \leq 5.42$°K, there is also a second-order transition connected with the appearance of a surface critical field. Good agreement is found with the Saint-James and de Gennes theoretical predictions. (auth)

25021 (N–71–10415) MIXED STATE OF SUPERCONDUCTORS. Hudson, Wayne R. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). 1970. 73p. (NASA-SP-240). NTIS.

The fundamental properties of superconductivity are reviewed. The Ginzburg–Landau equations are described and Abrikosov's solution is discussed. The vortex state is compared to a laminar state to determine which state is energetically more favorable. The experimental evidence that substantiates the vortex state is given. The results of tube magnetization experiments are presented, and the flux creep theory is derived. The flux flow models of Bardeen–Stephen and Nozieres–Vinen are compared with each other and with the experimental evidence. Three models for the viscosity coefficients are presented. The rigidity of the Abrikosov structure and the possible flux line pinning mechanisms are mentioned. (auth) (STAR)

25022 (NP–18742) DEPENDENCE OF SURFACE RESISTANCE ON FIELD LEVEL IN PURE SUPERCONDUCTORS. Halbritter, J. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Dec 1970. 20p. Dep. NTIS (U. S. Sales Only).

As in normal conductors, at plane surfaces of superconductors a magnetic field parallel to the surface is accompanied with states

localized in the penetration region of the magnetic field H. In cavities the rf magnetic field is parallel to the surface and will, therefore, induce these surface states in addition to changes of other states caused by H. These changes yield a strange dependence of rf surface resistance $R_s(H)$ on field level: for a certain field level H_R-enhanced rf absorption occurs due to the energy shift of the surface states, yielding a resonance peak in the surface resistance. With further increasing $H > H_R$, the surface resistance decreases and drops even below the value at $H \simeq 0$ due to the changed excitation spectrum. These observed structures in $R_s(H)$ of massive niobium cavities at Stanford indicate a nearly perfect niobium surface. In addition, the strongly decreased absorption at high field levels is an advantage for the practical application of niobium cavities in rf accelerators. (auth)

25023 ULTRASONIC INVESTIGATION OF STRONG-COUPLING SUPERCONDUCTIVITY IN LEAD. Sebastian, Richard Lee. College Park, Md.; Univ. of Maryland (1970). 97p. University Microfilms Order No. 71-4079.

Thesis.

An investigation of the strong-coupling properties of lead was made with longitudinal ultrasound for a frequency range up to 510 MHz. The results of this study are compared with computed theoretical values of the superconducting and normal-state longitudinal ultrasonic attenuation α_s and α_n. These computations are based upon a strong-coupling calculation by Nam and a numerical calculation for the energy-dependent renormalization and gap parameters for lead by Swihart, Scalapino, and Wada. The temperature and frequency dependences of the attenuation ratio α_s/α_n are explained in terms of the energy dependence of the electron mean free path. A shelf feature of the $\alpha_s(T)$ curve is observed at several ultrasonic frequencies. It is explained in terms of a Granato–Luecke model for amplitude-independent dislocation attenuation adapted to the superconducting state. Values are obtained for the damping force per unit length of the electron system on a dislocation loop and for the resonant frequency of the dislocation loops. At the highest frequencies another contribution of dislocation attenuation is identified. This attenuation is temperature-dependent, amplitude-independent, and appears to be linear in frequency. It represents a serious obstacle to the study of strong-coupling properties in lead for $ql \gg 1$. An intermediate-state amplitude-dependent magnetoacoustic effect is observed. This effect correlates strongly with features of the onset of the intermediate state observed directly in lead by Traueble and Essman. (Diss. Abstr. Int., B)

25024 FILAMENTARY SUPERCONDUCTING COMPOSITES. Wilson, M. N. (Rutherford High Energy Lab., Chilton, Eng.). Composites; 1: 341-4(Dec 1970).

Superconductors in the form of fine (10 μm) filaments perform much better than in bulk. Filamentary superconducting composites are, therefore, being used in the construction of superconducting magnets (auth) (UK)

25025 SEARCH FOR SUPERCONDUCTIVITY IN LITHIUM AND MAGNESIUM. Thorp, T. L. (Univ. of California, Berkeley); Triplett, B. B.; Brewer, W. D.; (and others). J. Low Temp. Phys.; 3: 589-602(Dec 1970).

Recent theoretical work suggests that magnesium and lithium should be superconducting in the m°K temperature range. Samples of each of these metals were cooled to a temperature of 4 m°K, measured by a gamma-ray anisotropy thermometer. Although the magnetic field was less than 10^{-2} Oe, no superconducting transitions were observed. The use of a nuclear orientation thermometer employing ^{60}Co in single-crystal (hcp) cobalt is described. (auth)

25026 RIGHI–LEDUC EFFECT IN THE MIXED STATE OF A TYPE-II SUPERCONDUCTOR. Sichel, E. K.; Serin, B. (Rutgers–The State Univ., New Brunswick, N. J.). J. Low Temp. Phys.; 3: 635-8(Dec 1970).

A transverse temperature gradient odd in magnetic field was observed in the presence of longitudinal temperature gradient in a thin strip of Pb + 7.5 at. % In with its plane perpendicular to the field. At 2.5°K, the ratio of the transverse to the longitudinal temperature gradient is proportional to field above the upper critical field, and has a maximum in the mixed state below this field. The Righi–Leduc effect has the same sign in the mixed state as in the normal state. (auth)

25027 PRESSURE EFFECT ON THE CRITICAL FIELDS OF THE SUPERCONDUCTING METALS Al, Ga, AND Th AND OF THE HIGH PRESSURE PHASE OF Ga. Palmy, C.; Olsen, J. L.; Flach, R.; De Trey, P. (Eidgenoessische Technische Hochschule, Zurich). pp 95-100 of Les Proprietes Physiques des Solides Sous Pression. Paris; Centre National de la Recherche Scientifique (1970). (In French).

From International Conference on the Physical Properties of Solids Under Pressure, Grenoble, France. See CONF-690908.

The effect of pressure on the superconducting metals aluminum, gallium, and thorium was investigated up to pressures as high as 25 kbar. The effect of pressure on the superconducting properties of metals is discussed. A critical-field curve for the high-pressure phase of gallium is given. (auth) (France)

25028 EFFECT OF UNIAXIAL STRESS ON THE SUPERCONDUCTING TRANSITION TEMPERATURE OF MONOCRYSTALLINE Nb_3Sn. McEvoy, J. P. (Clark Univ., Worcester, Mass. Radio Corp. of America, Princeton, N. J.). pp 101-5 of Les Proprietes Physiques des Solides Sous Pression. Paris; Centre National de la Recherche Scientifique (1970).

From International Conference on the Physical Properties of Solids Under Pressure, Grenoble, France. See CONF-690908.

Measurements were made of the stress dependence of the superconducting transition temperature (T_c) of single crystals of Nb_3Sn oriented in the (001) direction. The magnitude of the stress dependence of T_c is about 1,000 times that generally observed for elemental superconductors. The results imply that below the tetragonal transformation temperature (T_m), both cubic and tetragonal phases are present, and that the amount of tetragonal phase is sensitive to the applied stress at T_m. (auth) (France)

25029 BEHAVIOR UNDER PRESSURE OF ALLOYS WITH RARE-EARTH IMPURITIES. Coqblin, Bernard. (Paris Univ., Orsay, France). pp 179-90 of Les Proprietes Physiques des Solides Sous Pression. Paris; Centre National de la Recherche Scientifique (1970).

From International Conference on the Physical Properties of Solids Under Pressure, Grenoble, France. See CONF-690908.

The mechanism of interaction between the conduction and 4f electrons in rare-earth alloys was studied from experiments on the effect of cerium and gadolinium impurities on the superconductivity of lanthanum and lanthanum alloys. A new hamiltonian, which gives an explanation of some properties of these alloys, was constructed. (auth) (France)

25030 HARDENING OF SUPERCONDUCTORS THROUGH THE PRESENCE OF DISLOCATIONS. Freyhardt, Herbert C. (Univ., Goettingen, Ger.). Phil. Mag.; 23: 345-68(Feb 1971). (In German).

The interaction mechanisms between flux lines and dislocations were investigated in Nb single crystals deformed by torsion. The critical flux gradient was determined by differential magnetization measurements. The maximum interaction force p'_{max} between one obstacle and one flux line was obtained by a statistical analysis of the experiments. p'_{max} is of the order of 10^{-7} dyne and was found to decrease linearly both with increasing field and increasing temperature. The results can be explained in terms of a second-order elastic interaction between flux lines and dislocations. (auth) (UK)

25031 HARDENING OF SUPERCONDUCTORS THROUGH PRECIPITATION. Freyhardt, Herbert C. (Univ., Goettingen, Ger.). Phil. Mag.; 23: 369-92(Feb 1971). (In German).

The interaction mechanisms between flux lines and randomly distributed spherical Pb_3Na particles were investigated in single crystals of the Type-II superconducting Pb–7 at. % Na alloy. The volume pinning force pv was determined by differential magnetization measurements. The maximum interaction force p'_{max} between one obstacle and one flux line was obtained by a statistical analysis of the experiments. From the temperature and field dependence of p'_{max} conclusions were drawn concerning the underlying pinning mechanism. p'_{max} is of the order of 10^{-7} dyne (at 4.2 K) and a particle radius of 300 Å and for small fields is independent of the flux density. Evidence was obtained for an increase of pv with increasing temperature just below the critical temperature of the alloy. (auth) (UK)

25032 SUPERCONDUCTING SEMICONDUCTORS. Baumann, Kurt (Univ., Graz). Acta Phys. Austr.; 29: 241-50 (1969). (In German).

The properties of superconducting semiconductors are briefly reviewed. The early experimental data on the properties of GeTe, SnTe, and $SrTiO_3$ are summarized. The properties of highly doped semiconductors are given. The properties of strontium titanate as a superconducting semiconductor are given in detail. The Bardeen–Cooper–Schrieffer theory of semiconductors is analyzed critically. (J.S.R.)

25033 AC LOSSES OF HIGH-FIELD SUPERCONDUCTORS. Hanrahan, Donald J. (Naval Research Lab., Washington, D. C.). IEEE (Inst. Elec. Electron. Eng.), Trans. Magnet.; MAG-6: 833-9 (Dec 1970).

The Riemersma critical state model is applied to a long irre-

versible type-II superconductor carrying ac. Voltage waveforms, energy loss per cycle, and limiting values of effective resistivity are derived. For sinusoidal current of frequency f in 10-mil wire the critical current limit of resistivity is 4.06×10^{-14} f (Ω-m). An equivalent circuit consisting of a variable inductance is proposed. Experiments at 4.2°K on bifilar windings of bare and copper-plated single-strand 10-mil Nb–25 Zr wire at 60, 400, and 800 Hz gave only fair agreement with the model with indications that the model can be improved by including surface hysteresis and eddy-current effects. Experimental values of resistivity agree more with Zar than with Wisseman, leading to the conclusion that continuous ac power applications of superconductivity are not attractive for the sake of efficiency. There remains some promise for dc energy storage for discharge into pulse power devices. (auth)

25034 SPUTTERING TECHNIQUES FOR CONTROLLING COMPOSITION OF THIN FILMS OF HIGH-T_c SUPERCONDUCTING COMPOUNDS. Gavaler, J. R.; Janocko, M. A.; Hulm, J. K.; Jones, C. K. (Westinghouse Research Lab., Pittsburgh). J. Vac. Sci. Technol.; 8: 180-3(Jan–Feb 1971).

From 17th National Meeting of the American Vacuum Society, Washington, D. C. See CONF-701011.

Presently known, high-transition-temperature (≳15°K) superconducting materials have either the β-W (A-15) or rocksalt (B-1) crystal structure. Although these compounds retain the desired crystal structure over a wide composition range, optimum T_c's are obtained only when the compounds are nearly stoichiometric. Films of some of these materials, including compounds in the Nb–Al, Nb–Sn, and Nb–Al–Ge systems, have been prepared by sputtering. To control composition, various targets have been employed, including ingots made by arc melting, hot-pressed powder mixtures, and multiple targets. Compound formation was achieved in most cases (as verified by x-ray diffraction analysis) regardless of target material used; however, the T_c's of the films varied from <10°K to over 16°K. The influence of target material on stoichiometry and on T_c is discussed, and some of the high-field superconducting properties of the deposited films are reported. (auth)

25035 PREPARATION AND SUPERCONDUCTING PROPERTIES OF THIN FILMS OF SOME BINARY TRANSITION METAL ALLOY SYSTEMS. Spitzer, Hermann J. (Army Mobility Equipment Research and Development Center, Fort Belvoir, Va.). J. Vac. Sci. Technol.; 8: 184-7(Jan-Feb 1971).

From 17th National Meeting of the American Vacuum Society, Washington, D. C. See CONF-701011.

Thin films with thickness in the order of 3000 Å of Nb–Ti and Nb–Ta alloys were prepared by dc cosputtering onto fused quartz at 700°C at deposition rates of approximately 100 Å/min. As a function of composition, J_c–H characteristics were measured using pulsed transverse fields and pulsed currents and T_c's by monitoring the electrical resistance with temperature. Critical current densities, at comparable fields, are substantially higher than results reported earlier on these alloy systems. Also, the critical temperatures of these films were as high or higher than those of bulk material. The superior superconducting properties are attributed to the application of high substrate temperatures and the metallurgical processes involved therewith, especially the formation of β-phase solid solutions. (auth)

25036 DEPOSITION OF HIGH-PURITY Nb FILMS BY TETRODE SPUTTERING. Ogawa, S.; Takiguchi, K.; Hasegawa, T. (Industrial Research Inst., Osaka). J. Vac. Sci. Technol.; 8: 192-3(Jan-Feb 1971).

From 17th National Meeting of the American Vacuum Society, Washington, D. C. See CONF-701011.

Niobium thin films with extremly low resistivity (14.7 μΩ cm) have been deposited by tetrode sputtering in Ar gas purified by the getter action of titanium sublimation pump. The effect of gaseous impurities on the resistivity, superconducting transition temperature, and crystal structure were investigated. The superconducting transition temperature of such films was enhanced to 9.8 ± 0.1 K and the temperature coefficient of resistance was increased to $+3.0 \times 10^3$ ppM/deg. (auth)

25037 HIGH-RESOLUTION MAGNETO-OPTICAL TECHNIQUE FOR INVESTIGATING MAGNETIC STRUCTURE IN SUPERCONDUCTORS. Kirchner, H. (Siemens AG, Munich). Phys. Status Solidi (a); 4: 531-53(16 Feb 1971). (In German).

A high-resolution magneto-optical technique for observation of magnetic structures in superconductors that use the Faraday effect in thin films is reported. The achievable resolution is given by the resolution of light microscopy, i.e., about 5000 Å. By means of this technique a high-resolution study on the kinetics of domains in the intermediate state of type-I superconductors and a series of problems for which the topology of magnetic structures is relevant can now be performed. As an example for the potentialities of this technique the intermediate state in a superconducting lead film is studied, and the surface energy parameter of lead due to the Landau model (nonbranching model) is determined. It is estimated that an observation of the motion of flux lines in the mixed state of type-II superconductors appears to be feasible by a further improved technique. (auth)

25038 MAGNETIC FLUX STRUCTURE IN SUPERCONDUCTING NIOBIUM FOIL: INFLUENCE OF THE SPECIMEN SHAPE. Rowe, V. A.; Huebener, R. P.; Kampwirth, R. T. (Argonne National Lab., Ill.). Phys. Status Solidi (a); 4: 513-17(16 Feb 1971).

The domain structure of the magnetic flux distribution in thin foils of superconducting niobium was studied at 4.2°K for different sample shapes. The foil thickness was 18 μm. The experiments were carried out with a magneto-optical apparatus that utilizes the high specific Faraday rotation in thin films of a mixture of EuS and EuF_2. The macroscopic domain structure of the magnetic flux was found to be closely related to the sample shape. (auth)

25039 SUPERCONDUCTIVITY IN THE PSEUDOBINARY ALLOYS V_3Si–Nb_4Al. Newkirk, L. R.; Tusei, C. C. (California Inst. of Tech., Pasadena). Phys. Status Solidi (a); 4: 387-90(16 Feb 1971).

The compounds Nb_4Al and V_3Si were found to be mutually soluble. The superconducting transition temperature and the lattice spacings were measured over the entire range of the pseudobinary system. The lattice parameter varied smoothly with composition, and the variation of the superconducting transition temperature exhibited a deep minimum centered near the middle of the pseudobinary. This behavior was interpreted in terms of phonon propagation along the face-centered chains of atoms in the A15 structure and the effect of foreign atoms on this propagation. (auth)

25040 POSSIBLE METHOD OF DETERMINATION OF THE LOWER CRITICAL FIELD H_{c1} OF HARD TYPE-II SUPERCONDUCTORS. Handstein, A. (Deutsche Akademie der Wissenschaften zeu Berlin, Dresden). Phys. Status Solidi (a); 4: K157-60(16 Feb 1971).

Wires of a Nb–48 at. % Ti alloy were investigated. By means of cold deformation to different degrees and different heat treatments their metallurgical condition was changed. The magnetization was measured by a ballistic method at 4.2°K. The maxima of the magnetization curves of samples with different degrees of cold deformation and different heat treatments were found to fit a straight line. A value for H_{c1} was determined by an extrapolation of these values. The exact numerical agreement of the value extrapolated from the experiment with an estimated one supports the assumption that an experimental determination of H_{c1} is possible by means of the indicated method, even if only materials with strongly irreversible properties are available, and indicates that the regularity found is of general meaning. (M.H.R.)

25041 SUPERCONDUCTIVITY OF SOME NEW β-W COMPOUNDS. Kodess, B. N. (Inst. of Solid State Physics, Chernogolovka, USSR). Phys. Status Solidi (a); 4: K109-12(16 Feb 1971).

Measurements are reported on the superconducting transition temperature of V_3Al, V_3Ge, and solid solutions prepared by substitution of Ga or Al for Ge in V_3Ge. It is pointed out that by substitution of Al or Ga atoms for Ge atoms in V_3Ge not only an increase in T_c is observed but also a significant increase of the magnetic susceptibility and its temperature dependence. (M.H.R.)

25042 THEORY OF THE RESISTIVITY ANOMALY FOR A SUPERCONDUCTING FILM ABOVE ITS CRITICAL FIELD. Clarke, G. E.; Tilley, D. R. (Univ. of Essex, Colchester, Eng.). J. Phys., C (London); 3: 2448-57(Dec 1970).

The time-dependent Ginzburg–Landau equation is used to calculate the anomalous contribution to the conductivity of a dirty superconducting film due to thermodynamic fluctuations above the critical field. Expressions are for the conductivity along the film in the cases where the field is parallel, perpendicular, and inclined at an angle to the film, and also in the surface sheath case above H_{c3}. It is found that $\sigma \propto d^{-3}(H^2 - H_{c\|}^2)^{-1}$, $\sigma \propto d^{-1}(H - H_{c\perp})^{-1}$, $\sigma \propto (H - H_{c3})^{-1}$. The conductivity for a thin film in an inclined field is also calculated to obtain an interpolation formula between the parallel and perpendicular field results. (auth) (UK)

25043 SUBHARMONIC STRUCTURE IN SUPERCONDUCTING TUNNEL JUNCTIONS. Straessler, S.; Zeller, H. R. (Brown Boveri Research Center, Baden, Switzerland). Phys. Rev., B; 3: 226-8(1 Jan 1971).

XUM

Recent experiments showing that the intensity of the structure at eV = $2\Delta/n$ (2Δ = energy gap, n = 2,3,4,...) in a superconducting tunnel junction is proportional to the tunnel matrix element in the strong-coupling region are discussed. It is shown that for the odd series at eV = $2\Delta/(2n + 1)$ this behavior can be understood in terms of the accepted theory. However, the familiar explanation for the even series at eV = $2\Delta/2n$, based on the sharp increase of the surface resistance of the superconducting films at $\hbar\omega = 2\Delta$ due to quasi-particle excitation, is not consistent with the above experimental findings. A mechanism for the even series is proposed that involves the breaking of a tunneling Josephson pair caused by the oscillating electromagnetic field in the junction. (auth)

25044 EXPERIMENTAL TESTS OF PROPOSED RELATIONS BETWEEN THE CRITICAL FIELD AND DISLOCATION CELL STRUCTURE OF SUPERCONDUCTING NIOBIUM. Hill, D. C.; Rose, R. M. (Massachusetts Inst. of Tech., Cambridge). Met. Trans.; 2: 585-9(Feb 1971).

Experimental tests were made of the suggestion that the anomalously large magnitude and anisotropy of the resistive critical field of severely deformed niobium is due to the development of dense dislocation cell walls. The basis for the tests was the theoretical prediction that as the cell size approaches the coherence length ξ_{Nb} for superconductivity, the superconducting properties of the cell walls would be smeared out over the entire microstructure, destroying the anisotropy and a good part of the parallel critical field. Resistive measurements were made on swaged niobium wire and powder composites with true strains ranging up to 10.61, at temperatures from 4.2°K to T_c. Two approaches were used: either by raising the temperature above 4.2°K, ξ_{Nb} could be enlarged, or by increasing strain the cell size could be reduced. The predicted effects were indeed observed; from the temperatures at which the anisotropy disappeared, values of ξ_{Nb} were obtained which agree well with the expected magnitudes and variation of the cell size with cold work in drawn or swaged niobium. (auth)

25045 SPECIFIC HEAT AND SUPERCONDUCTIVITY OF CHROMIUM BASE ALLOYS WITH THE A-15 STRUCTURE. Fluekiger, R.; Heiniger, F.; Junod, A.; (and others) (Univ., Geneva). J. Phys. Chem. Solids; 32: 459-63(Feb 1971). (In French).

The low-temperature specific heat was measured in A 15-type binary alloys of chromium with Ru, Th, Os, Ir, Pt, Si, Ga and Ge. The electronic density of states was found to be higher in Cr alloys with a lower degree of atomic order. (auth) (UK)

25046 METHOD OF THE CORRELATION FUNCTION IN SUPERCONDUCTIVITY THEORY. Lueders, Gerhart; Usadel, Klaus-Dieter. Springer Tracts in Modern Physics. Volume 56. Berlin; Springer-Verlag (1971). 217p. $21.50.

The general formulation is first developed on a somewhat intuitive basis and afterwards as far as possible proved from the microscopic theory. A general discussion of the basic formulation and derivation of approximative formulations (mainly the Ginzburg–Landau approximation and the diffusion approximation) is presented. The formulations developed are applied to the calculation of critical magnetic fields for various geometries and to a sample consisting of superposed layers of different metals. (M.H.R.)

25047 GENERAL DERIVATION FOR SPIN PARAMAGNETIC SUSCEPTIBILITY OF ELECTRONS IN A SUPERCONDUCTOR. Nam, Sang Boo (Univ. of Virginia, Charlottesville). Phys. Rev., B; 3: 2946-9(1 May 1971).

Using the Green-function formulation, a general expression is obtained for the spin paramagnetic susceptibility of electrons in a superconductor, $\chi_s = (1 - \rho_s'/\rho)\chi_n$, where χ_n is the spin paramagnetic susceptibility of electrons in the normal state and ρ_s' is a pseudosuperelectron density. The result with ρ_s' replaced by the superelectron density is sufficiently general to apply to cases of strong coupling, to superconductors with magnetic and nonmagnetic impurities, and to type-II superconductors. A finite spin paramagnetic susceptibility at zero temperature for a pure strong-coupling superconductor is found. For impure superconductors, the result agrees very well with the results found in the Knight shift experiments. (auth)

25048 PHONON GENERATION AND DETECTION IN SUPERCONDUCTING LEAD DIODES. Dayem, A. H.; Miller, B. I.; Wiegand, J. J. (Bell Telephone Labs., Holmdel, N. J.). Phys. Rev., B; 3: 2949-61(1 May 1971).

A detailed experimental study of the behavior of Pb–Pb superconducting diodes in phonon generation and detection is presented. It is shown that the detection process occurs via pair breaking as well as phonon-assisted tunneling. The present experimental results do not resolve the distribution in energy of the phonons emitted by the generator. However, the derivative of the detected signal with respect to the generator current contains well-defined structure coincident with the phonon density of states of Pb calculated by McMillan and Rowell. (auth)

25049 RESONANCE SCATTERING AND SPATIAL VARIATION OF THE ORDER PARAMETER IN SUPERCONDUCTING ALLOYS. Kiwi, Miguel (Univ. of Chile, Santiago); Majlis, Norberto. Phys. Rev., B; 3: 2962-9(1 May 1971).

The problem of spatial variation of the order parameter in the neighborhood of a nonmagnetic impurity with broadened d levels is investigated near the superconducting critical temperature. It is shown that, due to resonance scattering, a long-range-order variation (compared to the coherence length) actually occurs and several expressions, obtained through different methods of calculation, are given and analyzed. This spatial variation leads to a small increase of the critical temperature as compared to its magnitude calculated using the average value of the order parameter; the analytical expression for this increase is given explicitly. The physical implications of the theoretical results are discussed on the basis of Anderson's theorem, and the main conclusion is that the incoherent d-state admixture at the Fermi level yields a much more important contribution to the change in thermodynamic properties, because of the presence of impurities, than the one due to the spatial variation of the order parameter. (auth)

25050 CURRENT-INDUCED FLOW OF DOMAINS IN THE INTERMEDIATE STATE OF A SUPERCONDUCTOR. Solomon, P. R.; Harris, Richard E. (United Aircraft Research Labs., East Hartford, Conn.). Phys. Rev., B; 3: 2969-73(1 May 1971).

Current-induced flow of superconducting domains similar to the flow of normal domains (flux flow) has been observed in the intermediate state. A theory (neglecting the Hall effect) is presented for the motion of domains in an intermediate state of arbitrary topology. Without pinning, the current in the normal regions is uniform and equal to J_0, the average current density. Domains move with velocity $v_D = cJ_0/\sigma H$. Both results agree with those previously derived for flux flow. Introducing pinning gives agreement between the predicted and measured velocities. (auth)

25051 ATTENUATION OF HIGH-FREQUENCY SOUND IN CLEAN TYPE-II SUPERCONDUCTORS NEAR H_{c2}. I. Cerdeira, Hilda A.; Houghton, A. (Brown Univ., Providence). Phys. Rev., B; 3: 2997-3003(1 May 1971).

The attenuation of high-frequency sound in clean type-II superconductors near the upper critical field H_{c2} is calculated. The approach used is a generalization of that used by Brandt, Pesch, and Tewordt to calculate the density of states of a pure type-II superconductor. It is shown that the attenuation is strongly dependent on mean free path even if $l \gg \xi_0$. In the low-temperature limit a simple functional relationship between attenuation, mean free path, and magnetic field is obtained. (auth)

25052 VOLTAGES INDUCED IN SUPERCONDUCTORS IN SUPERIMPOSED AC AND DC MAGNETIC FIELDS. Ohmer, Melvin Charles. Cincinnati; Univ. of Cincinnati (1970). 123p. University Microfilms Order No. 71-1544.

Thesis.

Voltages were observed in a superconductor in the presence of a transport current and a dc and ac magnetic field, and also in the presence of ac and dc magnetic fields when no transport current is flowing. In the first instance, flux flow and flux pinning in Type-II superconductors in the mixed state are studied. The ac magnetic field is imposed in order to attempt to eliminate pinning and thereby achieve ideal flux flow. The observation of the dc voltage when no transport current is flowing and the superconductor is in the presence of an ac magnetic field is believed to be the observation of a new phenomenon of superconductivity. The effect is found to depend on the temperature; the ac magnetic field amplitude, frequency, and orientation; the dc magnetic field magnitude and orientation; and on the sample surface. In addition, ac voltages were studied using a wave analyzer. There was considerable harmonic generation when the superconductor was in the mixed state. Both even and odd harmonics were observed up to the 20th harmonic. The harmonics did not occur when the sample was totally superconducting or totally nonsuperconducting. The odd harmonics behave quite differently from the even harmonics. Both harmonics have dramatic dc field dependences. It is believed that both the dc voltage and the ac voltages observed are the first direct measurements of the decay of supercurrents. (TSS) (Diss. Abstr. Int., B)

25053 SUPERCURRENT DENSITY DISTRIBUTION IN JOSEPHSON JUNCTIONS. Dynes, R. C.; Fulton, T. A. (Bell

Telephone Labs., Murray Hill, N. J.). Phys. Rev., B; 3: 3015-23(1 May 1971).

The form of the modulation of the critical dc Josephson current I_c of a tunnel junction by an applied magnetic field B is shown to be uniquely related to the supercurrent density distribution within the junction integrated over the direction of B. This relation is used to quantitatively determine these "current-density profiles" from $I_c(B)$ measured for Sn-oxide-Sn junctions with barriers prepared by plasma-discharge oxidation and for the novel light-sensitive junctions described by Giaever, in which the tunneling barrier is formed by an evaporated film of CdS. (auth)

25054 EFFECTS OF SURFACES ON THE INTERACTION OF LIGHT WITH IONIC CRYSTALS AND SUPERCONDUCTORS. Tong, Shuk Yin. Irvine, Calif.; Univ. of California (1970). 185p. University Microfilms Order No. 71-4303.

Thesis.

The normal modes of an ionic crystal slab bounded by a pair of (001) faces normal to the z direction but infinite in the x and y directions were determined without retardation effects by a combination of analytical and numerical methods. Cyclic boundary conditions are imposed on the ionic displacements at the faces of the slab normal to the x and y directions, but the presence of a pair of free surfaces is correctly incorporated into both the short-range and the long-range Coulomb contributions to the dynamical matrix. The contribution of optical surface modes to infrared absorption at infinite wavelength was calculated, and the effects on the dynamical properties of the slab of relaxing the intraplanar lattice parameter and the interplanar separations to minimize the potential energy of the slab were also determined. Retardation effects are then included in the solutions of the optical normal modes by solving the full Maxwell's equations using the dielectric tensor for an ionic slab. The dependence of the scattering efficiency for the Raman scattering of light from single-particle excitations in a superconducting slab at absolute zero on the frequency shift and on the scattering vector is calculated. The scattering process is found to take place within the skin depth of the material. The scattering cross section is zero for frequency shifts less than $2\Delta/\hbar$, where Δ is the energy gap of the superconductor, and has a jump discontinuity at the frequency shift of $2\Delta/\hbar$. The magnitude of the scattering efficiency is found to be at the present threshold of detectability. (Diss. Abstr. Int., B)

25055 SCATTERING AND TUNNELING OF ELECTRONIC EXCITATIONS IN THE INTERMEDIATE STATE OF SUPERCONDUCTORS. Demers, Jacques; Griffin, Allan (Univ. of Toronto). Can. J. Phys.; 49: 285-95(1 Feb 1971).

The anomalous scattering of Bogolyubov excitations at sharp N-S and S-N boundaries as well as quasi-particle tunneling in N-S-N and S-N-S geometries is discussed. The relation between the transmission resonances ($E > \Delta$) and the bound states ($E < \Delta$) in N-S-N and S-N-S geometries is explicitly exhibited. The extra thermal resistance due to scattering by a normal layer imbedded in a superconductor and by a superconducting layer imbedded in a normal metal is calculated with results different from those obtained by Shikin. (auth) (Canada)

25056 LONGITUDINAL ULTRASONIC ATTENUATION IN TANTALUM AT FREQUENCIES UP TO 1 GHz. Perz, J. M.; Roger, W. A. (Univ. of Toronto). Can. J. Phys.; 49: 296-301 (1 Feb 1971).

The attenuation due to interaction with conduction electrons of longitudinal sound propagating along [110] in a Ta crystal of resistance ratio 390 was measured over the frequency range 0.46 to 1.0 GHz. The product of the wave vector q and the electronic mean free path l determined from the frequency dependence of the normal state attenuation ranges over $1.8 < ql < 3.8$. The attenuation in the superconducting state in the absence of a magnetic field fits the BCS expression for $1.2 < T < T_c = 4.46$ K with $2\Delta(0) = 3.62 \pm 0.06\ kT_c$. The ultrasonic waves were generated by thin film CdS transducers, and the conversion efficiency was found to vary inversely with the active area of the transducer. (auth) (Canada)

25057 CURRENT DISTRIBUTION IN COMPOSITE SUPERCONDUCTORS. Sychev, V. V.; Al'tov, V. A. Izv. Akad. Nauk SSSR, Energ. Transp.; No. 5, 84-91(Sep-Oct 1970). (In Russian).

The Stekly model, which permits the analysis of the processes occurring in composite superconductors, is discussed. It is shown that, in the formulation of the initial equations describing the state of the composite conductor, an error was allowed in the model. The correction of this error is based on the fact that a current flows along the superconductor in the resistive state that exceeds the critical current. The system of equations describing the state of the composite conductor, where the current is divided between the superconductor and its support, is refined by the calculation of this effect. A detailed analysis of the effect of the indicated correction on the current in the superconductor is carried out. It is shown that, in many cases, this correction is a significant quantity. (tr-auth)

25058 MULTIFILAMENTARY SUPERCONDUCTING COMPOSITES. Critchlow, P. R.; Gregory, E.; Zeitlin, B. (Air Reduction Co., Inc., Murray Hill, N. J.). Cryogenics: 11: 3-10 (Feb 1971).

A brief theoretical argument is given outlining the reasons why fine filaments are necessary to prevent degradation arising from flux jumps. It is then shown that the composite must be twisted in order to benefit from the fine filaments. The manufacturing procedure is outlined and some common cross sections of the finished product are listed. Finally, it is shown how a combination of cold work and heat treatment may be used to give a large critical current density in the superconducting filaments. (auth) (UK)

25059 50-Hz LOSSES IN SUPERCONDUCTING NIOBIUM-TITANIUM. Bentley, R. C.; Graham, B. (Borough Polytechnic, London). Cryogenics: 11: 55-6(Feb 1971).

Losses in a type-II superconductor below H_c are due to surface imperfections, whereas above H_c, losses can be attributed to a combination of surface and bulk effects. Measurements are described of 50-Hz losses above and below H_c in a commercial, as-drawn, superconducting wire. The sample consisted of a 0.25-mm Nb-44 wt.% Ti, wire having a 0.4-mm Cu cladding, six meters of the wire being wound on a former in close bifilar fashion. A sinusoidal 50-Hz current was passed through the sample up to a value of 100 A (RMS). It was thought that identification of the loss components might indicate areas in which further work to improve the loss performance of commercial wires would be most profitable and would enable better comparison to be made with theoretical models. The measurements indicated that up to 70% of the total loss in the mixed state could be attributed to losses caused by surface imperfections and irregularities. If wires could be produced with surfaces as good as those given by rolling, a significant reduction in losses might be achieved. (UK)

25060 ENHANCEMENT OF THE CRITICAL CURRENT DENSITY IN NIOBIUM-TIN. Caslaw, J. S. (C and G Electronics Ltd., Swindon, Eng.). Cryogenics; 11: 57-9(Feb 1971).

In the studies described it was found that most third-component additions limited Nb_3Sn layer formation; only Cu enhanced both the formation and the critical current density (J_c) of the layer, J_c being increased by a factor of almost two. Details are given of the method of producing the sample of diffused Nb-Sn tape (ZrO_2 doped) and of sample testing. Measurements were made in a transverse magnetic field of up to 10T in a superconducting magnet, and at higher fields in the high-field test facility at the Royal Radar Establishment, Malvern, Eng. The third component (Cu) was introduced before heating by the use of a Sn-Cu alloy coating on the Nb base. The Cu appears to play an integral part in bringing together the Nb and Sn and effectively short-circuiting their normal diffusion paths. The critical temperature and the lattice parameters were found to be unchanged for the enhanced J_c material. Flux pinning is discussed. (UK)

25061 ANISOTROPIC ENERGY GAP IN Al. Leavens, C. R.; Carbotte, J. P. (McMaster Univ., Hamilton, Ont.). Solid State Commun.; 9: 75-8(1 Jan 1971).

Results are presented of calculations of energy gap anisotropy arising from anisotropy in the phonon spectrum. A distribution function for anisotropy is derived. It is employed to calculate the low-temperature specific heat in Al, which is found to agree with experiment. (auth) (UK)

25062 MAGNETIZATION OF STRONG-COUPLING SUPERCONDUCTORS FOR WHICH $\kappa_2(t) < \kappa_1(t) \approx 1/\sqrt{2}$. Fischer, Gaston; Usadel, Klaus D. (Univ. of Montreal). Solid State Commun.; 9: 103-5(15 Jan 1971).

The unusual magnetic and calorimetric behavior of a Pb + 2% In alloy found by Ehrat and Rinderer is explained in terms of a recent theory for $\kappa_2(t)$ of strong-coupling superconductors. (auth) (UK)

25063 EXPLANATION FOR THE SURFACE DEPENDENCE OF THE TUNNELING GAP IN Nb_3Sn. Weger, M. (Hebrew Univ., Jerusalem). Solid State Commun.; 9: 107-11(15 Jan 1971).

An explanation is proposed for the experimental results of Hoffstein and Cohen [Phys. Lett., 29A: 603(1969)] on tunneling into superconducting Nb_3Sn. In these experiments a strong de-

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pendence of the gap on the orientation of the surface was found. This dependence is explained here in terms of the linear chain model; a [100] surface cutting only one family of niobium atom linear chains, with a [111] surface cutting all three families of linear chains. (auth) (UK)

25064 DIELECTRIC BEHAVIOUR OF A DENSE ARRANGEMENT OF SUPERCONDUCTING PARTICLES. Meier, F.; Wyder, P. (Katholieke Univ., Nijmegen, Netherlands). Solid State Commun.; 9: 197-9(1 Feb 1971).

The dc-dielectric constant of a densely packed arrangement of small tin particles ($\phi \sim 1\mu$) embedded in paraffin was measured. There is a small difference in the capacitance of this artificial dielectric between the normal and superconducting states. The results can qualitatively be explained by assuming a tunneling charge transport between the particles. (auth) (UK)

25065 SUPERCONDUCTING Nb_3Sn DIFFUSION LAYERS. Pasotti, G.; Ricci, M. V.; Sacchetti, N.; Sacerdoti, G.; Spadoni, M. (CNEN, Frascati, Italy). J. Mater. Sci.; 6: 54-9(Jan 1971).

An experimental apparatus for the production of Nb_3Sn superconducting ribbon is described. The fabrication method for these ribbons takes advantage of the diffusion process of tin into niobium. Some details are given of the technique by which the superconducting properties of Nb_3Sn were tested. A number of preliminary experimental results are discussed with the purpose of pointing out the main fabrication parameters that influence the superconducting properties. Finally, future developments of this research program are outlined. (auth) (UK)

25066 THE CORRELATION BETWEEN THE SPINS OF THE CONDUCTION ELECTRONS AND THAT OF A MAGNETIC MOMENT IN A SUPERCONDUCTOR. Doman, B. G. S.; Gavan, T. (Univ. of Liverpool). J. Phys., C (London); 4: 31-3(1971).

It is shown that for superconductors for which $T_c \ll T_K$, the shape of the correlation function is the same as the shape for a nonsuperconductor, except at large distances, where it is smaller. (auth) (UK)

25067 INTERMEDIATE STATE OF THIN SUPERCONDUCTORS. Brandt, B. L. (Univ. of Rochester, N. Y.); Parks, R. D.; Chaudhari, R. D. J. Low Temp. Phys.; 4: 41-63(Jan 1971).

The state of a thin type-I superconductor in a magnetic field was examined to determine its dependence on the specimen thickness and on the value of the Ginzburg–Landau parameter κ. Three materials (aluminum, indium, and $In_{0.99}Pb_{0.01}$) with values of the Ginzburg–Landau parameter ranging from 0.19 to 0.34 were studied. Specimen thicknesses ranged from 200 to 200,000 Å. All of the materials studied were type-I or nonlocal superconductors in the bulk. Yet, it has been predicted that they would behave in ways characteristic of type-II or local superconductors if the specimen were sufficiently thin. For intermediate thicknesses the specimens were expected to be in one of many possible states. It was inferred from critical-field studies that the structure of the intermediate state in thin type-I superconductors is equivalent to the type-II vortex state for very thin films ($d \ll \xi_0$), and to the type-I macroscopic domain state for very thick films $d \geq 2\xi(t)$. For thicknesses between these limits, the intermediate-state structure takes on many forms as the area of each normal domain and the amount of flux threading it increase with increasing thickness. (auth)

25068 RESISTIVE VOLTAGE IN THE MIXED STATE OF SUPERCONDUCTING NIOBIUM IN THE PRESENCE OF SMALL OSCILLATORY MAGNETIC FIELDS. Huebener, R. P.; Kostorz, G.; Rowe, V. A. (Argonne National Lab., Ill.). J. Low Temp. Phys.; 4: 73-8(Jan 1971).

The resistive voltage near the critical current in the mixed state of superconducting niobium foils was measured in the presence of small oscillatory magnetic fields oriented parallel to the static magnetic field and perpendicular to the foil. The oscillatory field was found to cause an enhancement in the resistive voltage that depends on frequency and amplitude of the oscillatory field. The voltage increments show a maximum at a frequency ω^*, which varies with the static magnetic field and the specimen thickness and which depends very little on the lateral sample dimensions and the amplitude of the oscillatory field. The results are discussed in terms of eddy-current damping within the superconductor of an external magnetic field variation. (auth)

25069 ULTRASONIC ATTENUATION OF LONGITUDINAL AND SHEAR WAVES IN THE NORMAL AND SUPERCONDUCTING STATES OF NIOBIUM. Trivisonno, J.; Washick, J.; Keck, M. J.; Reifenberger, R. (John Carroll Univ., Cleveland). J. Low Temp. Phys.; 4: 97-109(Jan 1971).

Ultrasonic attenuation measurements of both longitudinal and shear waves in the normal and superconducting states were made on niobium single crystals. Frequencies between 50 and 450 MHz were employed. Independent of the mode, frequency, and crystal studied, a deviation of the attenuation ratio α_s/α_n from BCS behavior was observed. The dependence of α_s/α_n on frequency and crystal purity are interpreted in terms of a model that assumes a difference in electron mean-free path due to phonon scattering in the normal and superconducting states. (auth)

25070 MAGNETIC STRUCTURE OF SUPERCONDUCTORS. Essmann, Uwe; Traeuble, Hermann. Sci. Amer.; 224: No. 3, 75-84(Mar 1971).

Tiny quantized vortices appear in certain superconducting metals under the influence of a magnetic field. This macroscopic quantum effect can now be studied directly by a novel photographic technique. This technique, called decoration, is discussed. (M.H.R.)

25071 ANOMALOUS ac RESISTIVITY EFFECT IN Nb AND Sn AT HIGH STATIC FIELDS IN THE LIQUID HELIUM TEMPERATURE RANGE. van de Klundert, L. J. M.; van Ardenne, A.; van der Marel, L. C. (Twente Univ. of Tech., Enschede, Netherlands). Phys. Lett.; 34A: 321-3(5 Apr 1971).

The ac susceptibilities of Nb and Sn cylinders in the normal state at temperatures below T_c were measured. The results cannot be described by the formalism of the classical skin effect; therefore, a formal description is given. (auth)

25072 SUPERCONDUCTIVITY AND ELECTRON–PHONON INTERACTION IN Ta–V ALLOYS. Rapp, Oesten (Royal Inst. of Tech., Stockholm). Solid State Commun.; 9: 1-5(1 Jan 1971).

The electron–phonon coupling in Ta–V alloys is estimated from resistive measurements. It decreases rapidly with increasing V in Ta, in qualitative agreement with the observed transition temperature, T_c. A calculation of T_c from the strong-coupling equation gives good agreement with observed values for a constant Coulomb pseudo-potential and one adjustable parameter. (auth) (UK)

25073 OPTICAL PROPERTIES AND SUPERCONDUCTIVITY OF $NbSe_2$. Bachmann, R.; Kirsch, H. C.; Geballe, T. H. (Bell Telephone Labs., Allentown, Pa. Bell Telephone Labs., Murray Hill, N. J.). Solid State Commun.; 9: 57-60(1 Jan 1971).

The optical absorption of $NbSe_2$ was measured by a scanning calorimetric technique in the spectral range of 0.38 to 3.2 eV. Free-electron-like behavior is observed below 1 eV and the plasma frequency is determined by fitting the reflectance with Drude functions. Using this plasma frequency and the dc resistivity, a value for the electron–phonon coupling constant, λ, can be estimated. (auth) (UK)

25074 EFFECT OF THE DETAILED VARIATION OF PAIR POTENTIAL ON THE TOMASCH EFFECT. Nedellec, P.; Guyon, E. (Laboratoire de Physique des Solides, Orsay, France). Solid State Commun.; 9: 113-16(15 Jan 1971).

The previous calculations of the Tomasch oscillations [MacMillan and Anderson, Phys. Rev. Lett., 16: 85(1966)] in the density of state of superconductors are discussed critically. It is shown that these periodic structures should depend strongly on the variation of the pair potential in the film as well as at the interface. (auth) (UK)

Equipment and Devices

25075 (MIT-3700-14) RESEARCH ON INSTABILITY IN SUPERCONDUCTING MAGNETS. Final Report. Lax, Benjamin (Massachusetts Inst. of Tech., Cambridge. National Magnet Lab.). Dec 1970. Contract AT(30-1)-3700. 9p. Dep. NTIS.

Experimental techniques and computer-aided analytic studies undertaken together as a broad-based effort to investigate instabilities in high-field superconducting wires and ribbons are described. The laboratory work centered around the initiation of an instability in a superconducting sample under a variety of carefully devised, known environmental conditions. The analytic portion of the program was a realistic computer simulation of the behavior of a superconductor in a coil environment. Comparisons among the results of the two parts of the program were not only helpful in themselves, but also helped to indicate some possible aides in controlling the instabilities. (auth)

25076 LOW POWERED LIQUID HELIUM LEVEL SENSOR FOR USE IN A HELIUM DILUTION REFRIGERATOR. Clarke, G. R. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., E (London); 4: 243-4(Mar 1971).

A liquid-helium level detector, which operates at temperatures below 4.2 K and requires electrical power of less than 1 mW, is described. Such a device was built into the still of a helium dilution refrigerator where it can serve the dual role of still heater and liquid-phase indicator. (auth) (UK)

25077 SIMPLE JOSEPHSON JUNCTION GALVANOMETER. Smith, S. C.; Anderson, A. C. (Univ. of Illinois, Urbana). Cryogenics; 11: 53-5(Feb 1971).

Some problems associated with use of the Clarke simple superconducting quantum interference (or weak-link) device for the detection of small currents (Clarke, J. Phil. Mag. 13: 115(1966)) are enumerated, and a simple device that is not subject to these problems, but which has operating characteristics similar to those of the Clarke device, is described, together with a potentiometric circuit employing the device. (UK)

Plasma and Thermonuclear Physics

25078 NUCLEAR FUSION REACTORS. Proceedings of the British Nuclear Energy Society Conference, Abingdon, England, September 17–19, 1969. London; Institute of Civil Engineers (1970). 400p. £6. (CONF-690901).

Forty papers were presented at this conference. Individual abstracts were prepared for 32 papers. The other 8 papers have appeared previously in NSA; see NSA 23: 42349, 48934, 48935, 48936, and 51712 and NSA 24: 2972, 17978, and 23945. (TSS) (UK)

For abstracts of individual papers see: 24611, 24845, 24846, 25083, 25084, and 25145–25171.

25079 PLASMA PHYSICS INDEX. VOLUME 6, NO. 1, 1971. Bibliography, Author Index, Subject Index. Frankfurt am Main; Zentralstelle fuer Atomkernenergie-Dokumentation (1971). 130p.

This listing includes 505 articles on various aspects of plasma physics. (M.O.W.)

Confinement and Heating

25080 (LA-4611) PLASMA EXPERIMENTS WITH A THREE-METER THETA PINCH. Gribble, R. F.; Little, E. M.; Quinn, W. E.; Siemon, R. E. (Los Alamos Scientific Lab., N. Mex.). Feb 1971. Contract W-7405-eng-36. 11p. Dep. NTIS.

Extensive modifications to the Scylla IV theta pinch include a change from a one- to a three-meter-length coil, an increased energy storage, a new improved triggering system, and the addition of a crowbar system. The compression field is extended to 120 μsec by means of crowbar switches. Double-exposure holographic interferometry, side-on streak photographs, and neutron-emission measurements establish the following comparison with the previous one-meter version of the experiment: The plasma confinement time and neutron emission were extended from 3 to 10 μsec. The scaling of confinement time and plasma temperature from the one-meter device is accounted for by simple end-loss and shock-compression considerations. An m = 1 "wobble" of the plasma column is observed in the present experiment and is interpreted in terms of plasma rotation propagating from the ends at approximately the Alfvén speed. (auth)

25081 (MATT-800) IGNITION OF TOROIDAL FUSION REACTORS. Mills, R. G. (Princeton Univ., N. J. Plasma Physics Lab.). Nov 1970. Contract AT(30-1)-1238. 15p. (CONF-700912-11). Dep. NTIS.

From 5. annual intersociety energy conversion engineering conference; Las Vegas, Nev. (21 Sep 1970).

Although numerous methods of adding energy to laboratory plasmas have been demonstrated, there are severe difficulties with almost all of them when considered for ignition of a practical reactor. Plasma confinement experiments in Tokamak machines have demonstrated striking improvements in achievable density–confinement time products (the significant $n\tau$ parameter). This has stimulated considerable optimism for the future for this particular form of hypothetical reactor. It has further been realized recently that the Tokamak is peculiarly suitable for a single compressional heating cycle that should achieve ignition in a straightforward manner that is easily generalized to practical reactor configurations. (auth)

25082 (MATT-817) ANOMALOUS HEATING OF PLASMAS BY LASER IRRADIATION. Kaw, P.; Dawson, J.; Kruer, W.; Oberman, C.; Valeo, E. (Princeton Univ., N. J. Plasma Physics Lab.). Dec 1970. Contract AT(30-1)-1238. 26p. (CONF-701122-1). Dep. NTIS.

From International conference on laser-produced plasmas; Moscow, USSR (17 Nov 1970).

When an intense electric field oscillating near the electron plasma frequency is applied to a plasma, it excites parametric instabilities that drive up the ion-density fluctuations. The presence of moderate ion-density fluctuations leads to a strong enhancement of the high-frequency resistivity around the plasma frequency and hence to anomalous plasma heating. The enhancement of the resistivity, which can be physically attributed to a collective process involving the conversion of the electromagnetic wave energy into longitudinal plasma waves by a resonant-mode coupling process involving the ion waves, can typically be many orders of magnitude. The existence of such an effect is shown. A semiquantitative theory to explain the laboratory and computer experiments is also presented. (auth)

25083 PLASMA CONFINEMENT BY MAGNETIC FIELDS. Pease, R. S. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). pp 66-87 of Nuclear Fusion Reactors. London; Inst. of Civil Engineers (1970).

From International Conference on Nuclear Fusion Reactors, Culham, England. See CONF-690901.

Major developments in the theory and practice of plasma confinement by magnetic fields over the past ten years are reviewed, and the performances of some specific confinement systems are assessed. (UK)

25084 ALPHA-PARTICLE HEATING AND ENERGY BALANCE IN A MIRROR REACTOR. Kuo-Petravic, L. G.; Petravic, M.; Watson, C. J. H. (Culham Lab., Abingdon, Eng.). pp 144-63 of Nuclear Fusion Reactors. London; Inst. of Civil Engineers (1970).

From International Conference on Nuclear Fusion Reactors, Culham, England. See CONF-690901.

The substantial and rather conflicting literature on the use of the mirror machine as a thermonuclear reactor is reviewed. A number of new results are reported, especially on the role played by α-particle heating of the plasma in determining the ratio of the rate of production of thermonuclear energy to the injection power required to maintain the plasma in a steady state. This ratio, conventionally known as Q, is of crucial importance to the feasibility of a mirror reactor. It is concluded that the evaluation of the ultimate prospects of the mirror machine as a thermonuclear reactor must await further technological and economic investigations, since although present estimates suggest that a Q of 10 is required and shown in this paper to be unattainable with realistic mirror ratios, the Q values derived are fully compatible with the requirements of a system in which a rather large fraction of the power output is recirculated with high efficiency at low capital cost. If it were possible to recirculate the escaping charged particles with an efficiency of 75%, a self-sustaining mirror reactor would be feasible. (UK)

25085 HEATING OF THE ELECTRON COMPONENT OF MAGNETOPLASMA BY MAGNETIC PERTURBATIONS. Shukla, P. K.; Singh, R. P.; Singh, R. N. (Banaras Hindu Univ., India). Can. J. Phys.; 49: 395-401(15 Feb 1971).

The Boltzmann transport equation was solved for the change in the assumed Maxwellian distribution of electron velocity in response to certain magnetic perturbations. The heating of the electron component of the fully ionized and weakly ionized magnetoplasma was studied. The effect of propagating and localized magnetic perturbations was considered. Electron heating was estimated for certain adopted magnetic perturbation and magnetoplasma parameters. The feasibility of devising a laboratory experiment for electron heating is argued. (auth) (Canada)

25086 CONFINEMENT OF OHMIC-HEATED PLASMA IN THE STELLARATOR WITH LOW SHEAR. Burchenko, P. Ya.; Vasilenko, B. T.; Volkov, E. D.; (and others). (Inst. of Physics and Tech., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 15: 1856-9(Nov 1970). (In Russian).

Some investigations of plasma confinement in the stellarator sirius are described. It is shown that three regions of initial parameters exist in which dependences of plasma confinement time on its temperature and density are different. Some possible loss mechanisms are considered. (auth)

Diagnostics

Refer also to abstract 25273.

25087 (LA-4431-tr) MEASUREMENT OF THE PLASMA POTENTIAL IN THE PRESENCE OF A MAGNETIC FIELD USING AN EMITTER PROBE. Blanc, P.; Deschamps, P.; Occhionorelli, M. ([European Atomic Energy Community. Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires]). Translated for Los Alamos Scientific

Lab., N. Mex., from DPh-PFC/Note Interne No. 1033. 8p. Dep. NTIS.

The plasma potential was measured using an emissive probe in a magnetic field. The results agree well with those obtained by differentiating the Langmuir probe I–V characteristic. Comparison was also made with the theory of Bohm. (auth)

25088 (NP-18740) KINETIC STUDY OF THE HeI POPULATIONS IN A DENSE HELIUM PLASMA AND THE EFFECTS OF ABSORPTION ON THE SPECTRAL LINES. Bretagne, Jean (Paris Univ., Orsay (France). Laboratoire de Physique des Plasmas). Dec 1970. 61p. (In French). (LP-122). Dep. NTIS (U. S. Sales Only).

A spectroscopic investigation was made on the afterglow of a helium plasma produced by a focused laser beam. It was found that the spectral lines undergoing a harmonic Stark effect, indicated by satellite lines from the forbidden transitions $4^3F \rightarrow 2^3P$ and $4^1F \rightarrow 2^1P$, are not absorbed by this type of plasma. Consequently, their profiles cannot be attributed to self-absorption. The effect of absorption on the isolated HeI lines, from which the temperature and electron density were determined, was calculated. The plasma recombination coefficients were determined from calculations made on the population of the lowest energy levels, assuming almost stationary conditions. The type of equilibrium assumed by these levels is indicated. (auth) (France)

25089 ELECTRIC FIELD MEASUREMENTS IN A MAGNETOPLASMA USING THE DOUBLE-PROBE TECHNIQUE. Tunaley, J. K. E.; Knott, K. (European Space Research and Tech. Centre, Noorwijk, Netherlands). ELDO/ESRO Sci. Tech. Rev.; 2: 337-56 (1970).

The basic principle of the double-probe technique, which is frequently used for the measurement of dc electric fields, is analyzed. It is shown that, for this technique to work, an auxiliary frame of reference must physically exist, both for applications in vacuum and in a magnetoplasma. The general treatment of the method incorporates a detailed discussion on the role of the probe support when the method is applied in an ionized medium. From this, practical design criteria for experiments to be carried out under different conditions can be derived. It is shown that, in principle, the double-sphere technique is applicable for measuring electric fields, even outside the plasmapause, where the probe system is surrounded by a fairly dense cloud of photoelectrons. The paper concludes with some general statements on other methods for the measurement of electric fields. (auth) (France)

25090 MEASUREMENT OF ELECTRON DENSITIES OF HYDROGEN AND HELIUM PLASMA. Hashimoto, Shizuyo (Tokai Univ., Hiratsuka, Japan). Proc. Fac. Sci. Tokai Univ.; 5: No. 1-2, 75-80(Mar 1970).

The electron densities were measured of the plasmas obtained by passing a condensed discharge through Geisler tubes (the inner diameter of the capillary being about 1 mm) containing hydrogen of 5-mm Hg pressure and helium of 7-mm Hg pressure. The electron densities were determined using Inglis–Teller's formula in the Balmer series of hydrogen, and in the $2^1P_1 - n^1S_0$ and $2^1P_1 - n^1D_2$ series of helium. In these examples the mean electron densities were $n_H = 2.4 \times 10^{16}/cm^3$ and $n_{He} = 1.0 \times 10^{16}/cm^3$. (auth) (Japan)

25091 SCATTERING OF A LASER BEAM BY HIGH-TEMPERATURE PLASMAS. Ward, Gray; Pechacek, R. E.; Trivelpiece, A. W. (Univ. of Maryland, College Park). Phys. Rev., A; 3: 1721-3(May 1971).

The time-average intensity of electromagnetic radiation scattered by a 50-kV electron beam from a Q-switched laser beam, incident at 90° and polarized with E perpendicular to the electron beam, is measured as a function of angle with respect to the electron beam. The measured values agree with those calculated using a model that corrects for the fact that the scattering electrons pass through the scattering region during the period of observation. This correction is important in the measurement of plasma distribution functions by laser scattering for plasmas with electron temperatures greater than 10 keV. (auth)

25092 MEASUREMENTS OF PLASMA PARAMETERS IN A HIGH-FREQUENCY GLOW DISCHARGE USING THE ORIFICE PROBE. Hiraoka, Kenzo; Kamada, Hitoshi (Tokyo Univ.). Jap. J. Appl. Phys.; 10: 339-44(Mar 1971).

The electron temperature and the sheath potential in the plasma of radio-frequency glow discharge were measured by extracting the charged particles through a hole in a platinum and glass probe set on the wall of the discharge tube and subjecting the effused particles to a retarding electric field. The observed electron translational energy distribution is found to fit the Maxwellian distribution function. The electron temperature and the sheath potential increase with decreasing pressure. Addition of small amount of argon to helium results in a steep decrease of the electron temperature and the sheath potential. The electron temperature is kept nearly constant when the content of argon exceeds 10%. The lower values of the electron temperature obtained for polyatomic molecules are conjectured to be related with large cross sections for the energy exchange between plasma electrons and the relevant vibrational levels of molecules. (auth)

25093 PROFILE PARAMETER IN A PLASMA. Mukhopadhyay, S. (Univ. of Calcutta). Int. J. Electron.; 30: 193-5(Feb 1971).

The electron density profile parameter at S band using two microwave cavities in a mercury-discharge plasma for trapezoidal and Killan types of electron density distribution is calculated. (UK)

25094 SPECTROSCOPIC INVESTIGATION OF A DISCHARGE PLASMA IN CESIUM. Cussenot, J. R.; Fabry, M.; Vicherht, A. (Univ., Paris). Plasma Phys.; 13: 80-4(Jan 1971). (In French).

In a plasma produced by a hot cathode in a cesium vapour atmosphere, the influence of the cathode potential drop on the excitation states of ions and neutral particles is studied, and the effect on the distribution function of the electrons is discussed. Diagnostic spectroscopy used the emission spectra of the plasma. These temperature measurements are compared with those previously obtained with the aid of probes. (auth) (UK)

25095 SCHLIEREN STUDIES OF AN ELECTRIC FOCUSING DISCHARGE. Baconnet, J. P.; Cesari, G.; Coudeville, A.; Watteau, J. P. (CEA, Villeneuve-Saint-Georges, France). Onde Elec.; 51: 35-43(1 Jan 1971). (In French).

The plasma produced in front of the electrodes of a coaxial gun was examined. A ruby-laser beam was used to illuminate the plasma. Schlieren and shadowgram images were recorded with two electronic cameras having an exposure time of 1 ns. The structure of the plasma focused on the axis was not homogeneous. (auth) (France)

25096 TOPICS IN PLASMA DIAGNOSTICS. Podgornyi, I. M. New York; Plenum Publishing Corporation (1971). 223p. $22.50.

Translation of Lektsii po Diagnostike Plazmy.

The following broad topics are discussed: probe diagnostics, optical methods (including the use of lasers and holography), microwave diagnostics, and diagnostics with particle beams. (M.O.W.)

25097 COMPUTATION OF THE COMPOSITION OF A HIGHLY IONIZED PLASMA IN THERMODYNAMIC EQUILIBRIUM. Gautam, M. S.; Anandaram, M. N. (St. Francis Xavier Univ., Antigonish, Nova Scotia). Can. J. Phys.; 49: 492-5(15 Feb 1971).

A computer program for computing the composition of highly ionized plasmas using the Saha equations is described. The computations were carried out on an IBM-1130. Suppressed ionization potential, total number density of the ions, and partition functions for ion species are calculated. These calculations are used to obtain an iterative solution of seven Saha equations to evaluate the percentage composition of the various species of the plasma. Calculations are reported for oxygen between 10,000 and 80,000 K and all species up to O VIII are considered to be present in the plasma. (auth) (Canada)

25098 TIME RESOLUTION OF PLASMA POTENTIAL USING GRIDDED ELECTROSTATIC ANALYZERS. Robinson, J. E. (Massachusetts Inst. of Tech., Cambridge); Clarke, J. F. Rev. Sci. Instrum.; 42: 434-7(Apr 1971).

A system is presented for the time resolution of plasma potential using gridded electrostatic analyzers. The novelty of this method is the separation of consecutive current–energy characteristic curves and their display on a CRT. Using a 20-kHz bias signal, 30 to 50 consecutive 25-μsec sweeps are displayed on a CRT in a 1-msec time interval. This is sufficient for the study of low-frequency plasma fluctuations in transient confinement experiments. Application to the DCX-2 mirror machine is discussed. (auth)

25099 MEASUREMENT OF ELECTRON DENSITY AND TEMPERATURE IN SLOW THETA-PINCH PLASMA BY LASER SCATTERING. Hayase, K.; Okuda, T. (Nagoya Univ., Japan). Elec. Eng. Jap. (Engl. Transl.); 90: 113-20(Jan-Feb 1970).

The spectral distribution of scattered light from plasma is closely related to the incident wavelength, scattering angle, and electron density and temperature of the plasma. Based on this theoretical finding, the electron density and temperature of the slow theta-pinch plasma was accurately measured using a 10-MW ruby laser, and the results are compared with those obtained by the magnetic loop measurement. (auth)

Kinetics (General)

Refer also to abstracts 24852 and 24938.

25100 (JUL-691-PP) INVESTIGATION OF THE IGNITION PHASE OF THE ELECTRODELESS RING DISCHARGE. Geissler, Edgar (Kernforschungsanlage, Juelich (West Germany). Institut fuer Plasmaphysik). Aug 1970. 106p. (In German). Dep. NTIS (U. S. Sales Only).

The ignition behavior of the electrodeless ring discharge was investigated in the homogeneous periodically oscillating magnetic field. The commonly perturbing potential fields can be suppressed by an electrolyte. Since sensitive current measurements are not possible in the ring discharge, time-resolved measurements of the density rise were made with a microwave interferometer. (TSS)

25101 (MPI-PAE/EXTRATERR-29) THERMAL PLASMA AS A NORMAL-INTENSITY EMITTER IN THE WAVELENGTH RANGE FROM 1100 TO 3100 A. Boldt, G. (Max-Planck-Institut fuer Physik und Astrophysik, Munich (West Germany)). Jul 1969. 85p. (In German). Dep. NTIS (U. S. Sales Only).

With the help of a cascade electric arc, a thermal plasma was produced. It emits a series of optically thick spectral lines in the vacuum-uv range. The intensities in the core of these lines are given by the Kirchhoff–Planck function and can be calculated from knowledge of the plasma temperature. Interpolation between the central intensities of the optically thick lines yields, at each location in the range between 1100 and 3100 Å, an absolute intensity scale with which the intensity of the arc spectrum at each location of this wavelength range can be determined absolutely. The temperature measurement was made by four different spectroscopic methods independent of other intensity norms and gave 12,540°K with an uncertainty of ±1 to ±2%. An uncertainty from ±10 to ±20%, therefore, results for the absolute intensity value. The reproducibility error is kept in the limits of less than ±2%. Therefore, an absolute-intensity normal emitter of high accuracy and reproducibility is available for the vacuum-uv range between 1100 and 3100 Å. A comparison with the carbon-arc normal emitter showed, in the upper range between 2500 and 3100 Å (with tolerances of only several percent), consistency of the absolute intensity representation for arc sources. (tr-auth)

25102 ELECTRON TEMPERATURE DEPENDENCE OF A LOW-PRESSURE MAXWELLIAN NITROGEN PLASMA ON COMPOSITION. Leclert, G. (Univ., Nancy). J. Phys. (Paris); 31: 999-1003(Nov-Dec 1970). (In French).

The composition of a Maxwellian nitrogen plasma was determined from the rate coefficients of the elementary processes that occur at low pressures. The plasma is assumed to be optically thin; excitations and three-body collisions are neglected. Fifteen processes are considered. The rate coefficients are computed using the generally accepted experimental cross-section data. By means of a microreversibility formula, the radiative recombination cross sections are deduced from the photoionization cross sections. The computation of the rate coefficients was made for electron temperatures between 0.2 and 10 eV. Curves of the plasma ionization state corresponding to an initial pressure of 10^{-5} torr in this temperature range are presented. (auth) (France)

25103 COMBINED WORK OF HIGH-CURRENT ELECTRODYNAMIC PLASMA ACCELERATOR WITH SUPPLY SOURCE AS ONE-PHASE PHANEROPOLE MAGNETO-ELECTRIC GENERATOR. Kolesnikov, P. M.; Stolovich, N. N. (Inst. of Heat and Mass Exchange, Minsk). Inzh.-Fiz. Zh.; 19: 1038-45(Dec 1970). (In Russian).

Electrodynamic plasma acceleration in the coaxial gun is studied on the basis of an idealized model of current arc with no mass generation during the acceleration process. The differential equations describing simultaneous work of such a high-current plasma accelerator, condenser, and synchronous magnetoelectric generator are solved. Differential equations for electrodynamic plasma acceleration in an independent accelerator, with regard for mass transfer and resistance forces, are obtained. (auth)

25104 EQUILIBRIUM COMPOSITIONS AND THERMODYNAMIC PROPERTIES OF MIXED PLASMAS: He–N_2, Ar–N_2, AND Xe–N_2 PLASMAS AT ONE ATMOSPHERE, BETWEEN 5,000 AND 35,000°K. Capitelli, M.; Ficocelli, E.; Molinari, E. Bari, Italy; Universita de Bari ([1969]). 185p.

Numerical values of thermodynamic functions, of the density, of the concentrations of the relevant species, and of the specific heats at constant pressure (total and frozen) are presented in tabular form for the systems He–N_2, Ar–N_2, and Xe–N_2 at one atmosphere between 5,000 and 35,000°K. The tables also include the partition functions of the single species together with their first and second derivatives with respect to temperature, the specific heats of the single species, and the lowering of the ionization potentials of the neutral species. Numerical values are presented for every 1000°K and for compositions between 0 and 100% N_2 at intervals of 10%. (M.O.W.)

25105 TRANSPORT PROPERTIES OF MIXED PLASMAS: He–N_2, Ar–N_2, AND Xe–N_2 PLASMAS AT ONE ATMOSPHERE, BETWEEN 5,000 AND 35,000°K. Capitelli, M.; Ficocelli V., E. Bari, Italy; Universita de Bari (1970). 63p.

Numerical values of transport properties (thermal conductivity and viscosity) of the systems He–N_2, Ar–N_2, and Xe–N_2 at one atmosphere, between 5,000 and 35,000°K, are presented in tabular form for every 1000°K and for compositions between 0 and 100% N_2 at intervals of 10%. (M.O.W.)

25106 CURRENT SHEET TILT IN A PARALLEL-PLATE RAIL GUN. Pert, G. J. (Univ. of Alberta, Edmonton). Plasma Phys.; 13: 63-9(Jan 1971).

Spectrographic and probe measurements of a current sheet in a parallel-plate rail gun are presented. The discharge propagates at 6 cm/μsec into hydrogen at 0.5 torr. The measurements indicate that the sheet is tilted with gas flowing both normally and tangentially to the sheet. As a result of this gas flow, "bubbles" of plasma are periodically formed and detached from the discharge. (auth) (UK)

25107 NONEQUILIBRIUM EFFECTS IN AN ATMOSPHERIC ARGON ARC PLASMA. Giannaris, R. J.; Incropera, F. P. (Purdue Univ., Lafayette, Ind.). J. Quant. Spectrosc. Radiative Transfer; 11: 291-307(Mar 1971).

Thermal conditions in the asymptotic region of an atmospheric argon arc are determined spectroscopically and calculated using a single-fluid flow model. From a comparison of results and through the use of epochal considerations, the dominant nonequilibrium effect is shown to be one of ionization nonequilibrium induced by ambipolar diffusion. Excitation nonequilibrium effects are observed spectroscopically, and possible causes are suggested. (auth) (UK)

25108 FUSION POWER FOR INTERSTELLAR FLIGHT. Powell, Thomas Conley. Lexington, Ky.; Univ. of Kentucky (1970). 186p. University Microfilms Order No. 71-4138. Thesis.

A study was made to estimate the performance of fusion-powered starships, to define the operating regimes of interest for more detailed studies, and to identify some of the major problem areas. No attempt is made to carry out a detailed engineering design study. An optimization analysis shows that, for mass/power ratios greater than 100 kg/MW, the optimum specific thrusts for flights to the nearer stars are less than the maximum specific thrust of a fusion drive; i.e., fusion drives are acceleration-limited, not energy-limited, for interstellar flight. Even if mass/power ratios low enough to make fusion drives energy-limited can be achieved, the penalties associated with lower-than-optimum specific thrust are not large. Thus, there is no need for the total-mass-conversion drive and the interstellar ramjet, which, unlike the fusion drive, are far beyond today's technology. Unless very low mass/power ratios can be achieved, flight times to even the nearest stars will be longer than one present-day human lifetime. (TSS) (Diss. Abstr. Int., B)

Kinetics (Experimental)

25109 (AE-410, pp 35-62) INVESTIGATION OF RECOMBINATION PROCESSES IN A PULSED HELIUM DISCHARGE. (Aktiebolaget Atomenergi, Studsvik (Sweden)).

From General Physics Section progress report, fiscal year 1969-70.

A new system for recombination measurements with a discharge chamber made of glass is described. Results from experiments at lower pressures than 75 torr performed with quenching techniques are summarized. Experiments performed and observations made at higher pressure and at room temperature are described. The

main results of measurements of the plasma lifetime at higher gas temperatures and pressures up to 2.4 atm are given. (Sweden)

25110 PROPAGATION OF AN INTENSE RELATIVISTIC ELECTRON BEAM THROUGH A PLASMA BACKGROUND. Levine, L. S. (Naval Research Lab., Washington, D. C.); Vitkovitskii, I. M.; Hammer, D. A.; Andrews, M. L. J. Appl. Phys.; 42: 1863-9(Apr 1971).

Experiments were performed to study the propagation of an intense relativistic electron beam [input $(\nu/\gamma) \approx 2.5$] in a drift tube filled with either neutral gas or preexisting plasma. Beam front velocity, magnetic neutralization, and energy transport are measured. Results for propagation into neutral gas confirm previous work. Propagation into a preionized background is characterized by nearly complete magnetic neutralization. However, the beam front velocity never exceeds 60% of its potential value, and a two-stream instability is suggested as a possible explanation. The efficiency of beam energy propagation through the plasma is found to depend on the neutral background density, and a possible cause of this effect is suggested. Hollow-beam profiles are observed under suitable conditions. (auth)

25111 ENERGY FLOW IN THE COLLISION OF TWO PLASMA STREAMS. Takeda, Yasumasa (Nihon Univ., Tokyo). J. Phys. Soc. Jap.; 30: 1178-87(Apr 1971).

The axial distribution of transverse energy density during the collision of two plasma streams was measured by means of four magnetic loops arranged axially in the region of a guide field. The transverse energy density has the maximum, 4×10^{15} eV/cm^3, in the midplane, which is about five times larger than that of a one-sided plasma stream. The transverse energy density in the midplane decreases typically by a factor of 4 in 20 μsec, and the axial distribution is flattened out. It is not possible to account for this rapid decay of plasma diamagnetism quantitatively by the adiabatic expansion model developed by F. Waelbroeck et al. A simple model of axial thermal conduction is developed in which the energy is transported to cold plasma regions through shock fronts. Predictions of the model concerning the variation of plasma diamagnetism indicate that the energy flow due to parallel thermal conduction cannot be excluded. (auth)

25112 PROFILES OF He I 4471 AND 4922 A IN A PULSED ARC. Nelson, R. H.; Barnard, A. J. (Univ. of British Columbia, Vancouver). J. Quant. Spectrosc. Radiative Transfer; 11: 161-7(Feb 1971).

Detailed measurements were made of the profiles of the lines He I 4471 and 4922 Å in a pulsed arc plasma for electron densities in the range 3×10^{16} to 10^{17} cm^{-3}. The relative intensities and the shapes of the allowed and forbidden components are in agreement with computed profiles, but the components are observed to be closer together than was predicted. (auth) (UK)

25113 INTERACTION BETWEEN A FULLY IONIZED PLASMA AND A NEUTRAL GAS BLANKET. Lehnert, B.; Bergstroem, J.; Holmberg, S.; Wilner, B. (Royal Inst. of Tech., Stockholm). Phys. Scr.; 1: 39-45(1970).

Experimental studies were performed of a fully ionized magnetized plasma generated in a poloidal magnetic field by a transverse electric field applied between two electrodes and surrounded by a neutral gas blanket. The rotating plasma generated in the crossed fields is released from its energy source, and its rotation is stopped. The plasma decay is then studied in the absence of macroscopic motions, with the exception of those from a slow diffusion process. The state of ionization is determined by suddenly giving the plasma a small pulse of angular momentum which, after a short time, is recovered as a current pulse extracted by means of a short-circuit between the electrodes. The pulse becomes a measure of the state of ionization and shows that the rate of penetration of neutral gas into the plasma is strongly delayed at high plasma densities, in agreement with theory. The velocity field of a quasi-stationary, rotating plasma was investigated spectroscopically by observing the Doppler shifts of various spectral lines. The results agree with theoretical predictions of the velocity and temperature distributions within the plasma region. The results also support the prediction that the interior of the plasma should be screened from the surrounding neutral gas. (auth)

25114 EXPERIMENTAL DETECTION OF MULTIVELOCITY STREAM FORMATION WITH NONLINEAR BEAM–PLASMA INTERACTION. Gabovich, M. D.; Kovalenko, V. P. (Inst. of Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 15: 1893-6(Nov 1970). (In Russian).

The strong nonlinear effects of wave front "overturning" and multivelocity stream formation were detected in an electron beam–plasma interaction with a special electron energy-spectrum analyzer. It is shown that, with preliminary beam modulation, there is no broadening of the energy distribution function of beam electrons despite the intensive beam–plasma interaction. (auth)

Kinetics (Theoretical)

Refer also to abstracts 24887 and 25272.

25115 (COO-1726-68) BIT-PUSHING AND DISTRIBUTION-PUSHING TECHNIQUES FOR THE SOLUTION OF THE VLASOV EQUATION. Symon, K. R.; Marshall, D.; Li, K. W. (Wisconsin Univ., Madison). Oct 1970. 60p. (CONF-701113-7). Dep. NTIS.

From 4. conference on numerical simulation of plasmas; Washington, D. C. (2 Nov 1970).

In a bit-pushing program a plasma is simulated by manipulating a pattern of bits in the computer memory representing the pattern of particles in phase space. The method is analyzed and compared with conventional particle-pushing techniques. In a distribution-pushing program the particle distribution function is modified according to the leap-frog equations of motion for the particles. Algorisms are developed for accuracy and efficiency. Sample results of both kinds of programs are presented. Results are presented from a one-and-one-half-dimensional distribution pushing program simulating a plasma beam emerging from a circular hole. (auth)

25116 (ITF-70-93-P) QUANTUM STATISTICS OF THERMAL PLASMAS IN EQUILIBRIUM. I. THE METHOD OF EFFECTIVE POTENTIALS. Kel'bg, G.; Ebeling, W. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1970. 14p. (In Russian). (CONF-700648-2). Dep. NTIS (U. S. Sales Only).

From 3. conference on statistical physics and physical kinetics; L'vov, USSR (Jun 1970).

A statistical theory for the thermodynamic properties of nondegenerate nonrelativistic plasmas is developed. Following the method of effective potentials, the calculation of the partition function for plasmas is reduced to the corresponding classical problem. The result of numerical calculations for the binary Slater sums and the second virial coefficient of hydrogen plasmas are given. (auth)

25117 (ITF-70-94-P) QUANTUM STATISTICS OF THERMAL PLASMAS IN EQUILIBRIUM. II. DENSITY AND FUGACITY EXPANSIONS. Ebeling, W.; Kel'bg, G. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1970. 16p. (In Russian). (CONF-700648-1). Dep. NTIS (U. S. Sales Only).

From 3. conference on statistical physics and physical kinetics; L'vov, USSR (Jun 1970).

The expression for the second virial coefficient of the density expansion is calculated explicitly in the case of small plasma parameters. Using this result, the free energy of the quantum plasma is derived without approximations up to the order $N^{\frac{1}{2}}$, where N is the density. In the case of lower temperatures, the density expansions are replaced by fugacity expansions. The latter describe the formation of atoms and molecules as shown for the example of hydrogen plasmas. (auth)

25118 (MATT-814) TENSOR-PRESSURE FLUID SIMULATION OF AN MHD PLASMA. Bowers, E.; Winsor, N. (Princeton Univ., N. J. Plasma Physics Lab.). Nov 1970. Contract AT(30-1)-1238. 26p. (CONF-701113-5). Dep. NTIS.

From 4. conference on numerical simulation of plasmas; Washington, D. C. (2 Nov 1970).

A one-fluid model of a low-pressure plasma in a toroidal geometry is presented. For laboratory parameters, it demonstrates the existence of shock structure in the presence of resistivity and viscosity leading to containment times of the order of milliseconds. The model computes the time evolution on a two-dimensional mesh of the plasma density, potential, and three-velocity and current components. The momentum equation includes the effects of bulk viscosity and gyroviscous stress. The generalized Ohm's law contains the resistive, Hall, and electron-pressure terms. The time step can be taken large enough (of order 1 μsec for the stellarator case) for simulations comparable to a complete laboratory experiment to be performed in a reasonable amount of computer time (about 20 minutes of 360/91 time). Mathematically, the equations are in integro–differential form. A linear stability criterion is presented for the sum–difference formulations of these equations. Acoustic, geodesic acoustic, drift, and convective modes severely constrain the choice of difference formulations. The Courant–

Isaacson–Rees and the Lax–Wendroff schemes were used for the convective term in the momentum equation. It was found that the Courant–Isaacson–Rees scheme introduced a numerical viscosity which was unacceptably large in the presence of the resistive rotational instability. On the other hand, the Lax–Wendroff scheme may couple surfaces more strongly when large-amplitude modes or dissimilar shock structures are present on adjacent surfaces. (auth)

25119 (MATT–822) CHOICE OF GRIDS IN LOW-β FLUID COMPUTATIONS. Winsor, N. K.; Bowers, E. C. (Princeton Univ., N. J. Plasma Physics Lab.). Jan 1971. Contract AT (30-1)-1238. 43p. (CONF-701113–6). Dep. NTIS.

From 4th Conference on numerical simulation of plasmas; Washington, D. C. (2 Nov 1970).

When the magnetic stress is large compared to the plasma pressure, the magnetic field geometry controls the plasma behavior. For finite-difference calculations of this behavior, the grid should be chosen to fit the geometry. Three coordinate systems are presented, and their relative merits are compared. Some general techniques for a low-β simulation—in particular, the conservation-law form of the equations and the "symbolic" style of programming—are discussed and recommended. A proposed simulation of the adiabatic toroidal compression experiment is used as an illustration of the advantages of writing a fluid code in curvilinear coordinates. (auth)

25120 (ORNL-TM-3351) PERTURBATION THEORY IN TOROIDAL PLASMA. Burt, Philip B. (Oak Ridge National Lab., Tenn.). Mar 1971. Contract W-7405-eng-26. 16p. Dep. NTIS.

A plasma confined within a toroidal conductor of infinite conductivity is considered from the point of view of the magnetohydrodynamic description. The equilibrium description for an axially symmetric system leads to an integro–differential equation connecting the toroidal current density and the scalar pressure. The assumption that this system can be described by a perturbation treatment in which the perturbation parameter is the inverse aspect ratio is shown to be invalid except for special cases. The demonstration is based upon explicit construction of the kernel of the integro–differential equation in a form suitable for examining the limit of large aspect ratio. This kernel contains both positive and negative powers of the aspect ratio as well as logarithmic functions of this quantity. Finally, in the limit of indefinitely large aspect ratio, the kernel is shown to exist. (auth)

25121 TIME-DEPENDENT ELECTRON VELOCITY DISTRIBUTION IN A FULLY IONIZED GAS UNDER THE ACTION OF ELECTRIC AND MAGNETIC FIELD. Sestak, B. (Tech. Univ., Prague). Czech. J. Phys.; 21: 153-60(1971).

Boltzmann's equation in crossed electric and magnetic fields is solved provided that electron–electron collisions are neglected. The velocity distribution function is obtained in analytic form; the runaway rate is calculated in dependence on the magnetic field and time. (auth)

25122 HIGHLY IONIZED PLASMA COLUMN OF LOW-PRESSURE DISCHARGE IN A LONGITUDINAL MAGNETIC FIELD. Kawaguchi, M. (Nagoya Univ., Japan); Yamamoto, K.; Itoh, S. Elec. Eng. Jap. (Engl. Transl.); 90: 68-74(Jan-Feb 1970).

Equations describing various characteristics of the highly ionized plasma column in the magnetic field, where interactions between charged particles and neutrals cannot be neglected, are derived. Numerical solutions are obtained by the Runge–Kutta–Gill method. The results indicate that the plasma column is focused as the magnetic field is increased. The density distribution approaches the J_0 distribution as the Coulomb interaction becomes weak. (auth)

25123 COMBINED EFFECTS OF IRRADIATION AND CONDUCTION IN PLASMA GENERATED IN ELECTRIC ARCS. Boffa, Cesare (Istituto di Fisica Tecnica, Turin). Atti Accad. Sci. Torino. I. Cl. Sci. Fis., Mat. Natur.; 104: 437-48(May-Jun 1970). (In Italian).

The combined effects of conduction and irradiation in plasmas generated by means of electric arcs are considered. The results obtained by assuming an approximation expression of the angular distribution of the irradiation intensity are presented. The contribution from the different mechanisms of energy exchange at different pressures is examined, and their effects on the temperature profile in the arc are studied. A method for the numerical solution of the problem, which considers the part of the irradiation in the ultraviolet subject to self-absorption separately from that of greater wavelength not absorbed, is also presented. (tr-auth)

25124 RECOMBINATION PROCESSES DURING EXPANSION OF A LASER-PRODUCED PLASMA. Mattioli, M. (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). Plasma Phys.; 13: 19-28(Jan 1971).

The decay of a spherical LiH plasma, produced by laser radiation, is considered; three-body and radiative recombinations are taken into account. Freezing of the degree of ionization is possible if the energy transferred to the plasma in the three-body recombination processes is considered. Numerical computations are compared with previously published experimental results. (auth) (UK)

25125 EXPLANATION OF THE APPARENT NONOBSERVATION OF NEAR PLASMA SATELLITE EMISSION LINES IN HIGHLY TURBULENT PLASMAS. Burgess, D. D. (Imperial Coll. of Science and Tech., London). J. Phys., B (London); 4: L7-10(Feb 1971).

Plasma satellite emission lines separated by twice the plasma frequency $2\omega_p$ from allowed lines should often be stronger than the weaker (far) Baranger–Mozer ω_p satellite of forbidden lines. Confusion between these features probably explains those observations in which the near Baranger–Mozer line has appeared to be anomalously weak relative to the far ω_p satellite. (auth) (UK)

25126 FORBIDDEN OPTICAL TRANSITIONS STIMULATED BY PLASMA TURBULENCE IN HELIUM. Ben-Yosef, N.; Rubin, A. G. (Air Force Cambridge Research Labs., Bedford, Mass.). J. Quant. Spectrosc. Radiative Transfer; 11: 1-6(Jan 1971).

Satellites to the forbidden 1s2p–1s3p transition stimulated by strong plasma oscillations were observed. Internal structure of the satellites related to the spectrum of the plasma turbulence was found. The light emitted at these satellites is polarized, showing that the plasma electrostatic field is anisotropic. (auth) (UK)

25127 SHOCK WAVE MOTION IN PLASMA WITH EXCITED ELECTRONS CONFINED IN ELECTROMAGNETIC FIELD. Agostinelli, Cataldo. Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur.; 48: 499-507(May 1970). (In Italian).

The motion of a hot plasma in an electromagnetic field is considered on the assumptions that the ions are at rest, that the effect of the electron–ion collisions is negligible, and that the action of the electrons is equivalent to an isotropic pressure. On the supposition that a shock wave forms in the plasma, the equations of discontinuity, through the shock layer, are established relative to electron velocity and density and the electrical and magnetic fields. The results obtained are applied to the case of a plane shock wave that advances in a plasma at rest, and the cases and conditions in which a shock wave can arise are determined. (auth)

25128 PLASMA COMPUTER SIMULATION IN CYLINDRICAL GEOMETRY WITH AZIMUTHAL SYMMETRY. Le Bail, Roland Claude Joseph. Stanford, Calif.; Stanford Univ. (1970). 136p. University Microfilms Order No. 71-2791.

Thesis.

A computer program was developed which simulates the behavior of a quasi-electrostatic plasma in cylindrical geometry with azimuthal symmetry. The model is represented by an assembly of approximately 2000 charged rings which are confined by a fixed magnetic-mirror field configuration. The motion of the particles under the influence of their self-consistent electric field and the imposed magnetic field is computed, stepwise in time, according to Newton's law of motion. The bulk of the research was directed toward accuracy and speed both for the solution of Poisson's equation and the equations of motion. (TSS) (Diss. Abstr. Int., B)

Production

25129 (JUL-708-PP) PRODUCTION AND INCLUSION OF A DENSE AND HOT PLASMA IN THE SPINDLE-CUSP CONFIGURATION. Kugler, Erwin (Kernforschungsanlage, Juelich (West Germany). Institut fuer Plasmaphysik). Oct 1970. 74p. (In German). Dep. NTIS (U. S. Sales Only).

The properties and construction of a spindle-cusp compression experiment are described. The measurement results of the plasma parameters during the preheating, compression, and confinement phases are reported. The various models of the plasma loss from the cusp geometry are calculated and compared with the experimental results. (tr-auth)

XUM

25130 EXPANSION OF A LASER-PRODUCED PLASMA INTO A VACUUM. Inoue, N.; Kawasumi, Y.; Miyamoto, K. (Nagoya Univ., Japan). Plasma Phys.; 13: 84-7(Jan 1971).

Radiation from a ruby laser with a maximum power of 80 MW (total energy of 1.2 J) was focused on a tip if a filament of polyethylene $(CH_2)_n$ with a size of 0.2×0.2 mm^2 suspended in a vacuum. About one-tenth of the total energy was absorbed in the target. Measurements were performed with an ion energy analyzer set up at an angle of 90° from the laser incidence and with an electrostatic probe with twin electrodes. The ion species in the plasma was C^{2+} only. The distribution of ion energy had a peak at an energy of about 70 eV. (auth) (UK)

Stability

Refer also to abstract 25178.

25131 (JUL-700-PP) PROCEDURE FOR NUMERICAL CALCULATION OF TOROIDAL EQUILIBRIUM CONFIGURATION OF SYMMETRICALLY ROTATING, FIELD-FREE PLASMAS. Janicke, Lutz (Kernforschungsanlage, Juelich (West Germany). Institut fuer Plasmaphysik). Oct 1970. 55p. (In German). Dep. NTIS (U. S. Sales Only).

Under the assumption that the plasma is field-free and is separated from the external magnetic field by a thin current layer, the calculation of equilibrium configurations means the solution of a free boundary-value problem. A numerical method is first developed for the solution of the simple boundary-value problem in which all boundaries are assumed stable. If rotation symmetry is assumed, an existing skin effect is considered in the coil system producing the magnetic field. An iteration method is formulated which, starting with an estimated location of the free boundary (plasma surface), so deforms it gradually that from step to step the condition at the free boundary (equilibrium condition for the plasma) is always better fulfilled. Therefore, the aspect ratio of the plasma torus is subject to no limitation. After the convergence of the method is shown by a simple example, a series of equilibrium configurations that appear for the coil system of a hard-core theta pinch is discussed. (tr-auth)

25132 COLLISIONLESS STABILITY OF AN INHOMOGENEOUS, CONFINED, PLANAR PLASMA. Holdren, John Paul. Stanford, Calif.; Stanford Univ. (1970). 236p. University Microfilms Order No. 71-2773.

Thesis.

The linear stability of a one-dimensional, self-consistently confined sheet of plasma is investigated in the collisionless limit. Aside from the linearity and noncollision assumptions, none of the traditional approximations are employed (for example, small gyro radii, nearly homogeneous densities and fields in the unperturbed equilibrium, artificially simple distribution functions, or restriction to electrostatic perturbations). The method consists of integrating the (relativistic) ion and electron Vlasov equations along their characteristics, the exact (numerically obtained), unperturbed particle orbits. The method is demonstrated here by investigating the tearing mode in a one-dimensional equilibrium composed of interstreaming Maxwellian distributions of ions and electrons and confined in consequence of its self magnetic field. The parameters correspond to a deuterium plasma at $T_i = T_e = 170$ keV, so the electrons are fully relativistic. Eigenfunctions and eigenvalues are obtained in the low-frequency domain appropriate to the tearing mode. The calculation reproduces the known marginal stability condition for sheet-pinch tearing, including the spatial dependence of the mode, to within .5%, and confirms the other predictions of previous, approximate theories qualitatively. No other unstable modes are found, the tearing growth rate increases as wavelength increases from the marginal value, and the rate decreases for propagation increasingly oblique to the equilibrium magnetic field. Quantitatively, the growth rates obtained are orders of magnitude less than those from previous, approximate Vlasov approaches, but of the order of or greater than those from a two-fluid calculation. The surprising difference between the "exact" and approximate Vlasov growth rates is explained by relativistic and orbit effects not present in the previous work. (TSS) (Diss. Abstr. Int., B)

25133 EXPERIMENTAL STUDY OF A MAGNETICALLY CONFINED, UNNEUTRALIZED, ELECTRON PLASMA. Kapetanakos, Christos A. College Park, Md.; Univ. of Maryland (1970). 193p. University Microfilms Order No. 71-4910.

Thesis.

Some properties of an unneutralized, magnetically confined, "hot" electron plasma were studied experimentally. Specifically, this work is concerned with studies of trapping, heating, emission of cyclotron radiation, equilibrium, and stability of an electron cloud as produced in a time-varying magnetic mirror field by external injection of an electron beam. In general, the experiment involves the injection of a 2-mm diameter, 0.1-A, 3.0-kV, 1-μsec electron beam into a 60-gauss magnetic field. The rising mirror field traps approximately 10^{11} electrons, which are subsequently compressed in 1 msec to a 15-kG midplane field. At the peak of the compression the mean energy of the confined electrons is 0.5 MeV, and their distribution has a spread of 0.45 MeV at half maximum. The containment time of the electron cloud is about 25 msec. As a consequence of the fact that destructive instabilities do not occur in the time scale of the experiment, it is likely that the containment time can be considerably enhanced by increasing the time constant of the decaying magnetic field. Moreover, neither slow neutralization of the space charge by the ionization of the residual gas nor fast neutralization by a puff of injected neutral gas render the electron plasma grossly unstable. (Diss. Abstr. Int., B)

25134 FEEDBACK-CONTROLLED STEADY-STATE PLASMA. Brown, I. G.; Compher, A. B.; Ehlers, K. W.; (and others) (Univ. of California, Berkeley). Plasma Phys.; 13: 47-61(Jan 1971).

A current-free magnetized plasma with independently variable density and electron temperature was produced and studied. The plasma, which may be either steady-state or pulsed, is generated at one end of a 1.5-m-long vacuum system by a 10-GHz microwave discharge at electron gyroresonance in a dc magnetic field. In the main body of the plasma the magnetic field can be varied from 1 to 10 kG and plasma densities $5 \times 10^8 \lesssim n_e \lesssim 5 \times 10^{11}$ cm^{-3} and temperatures $2 \lesssim T_i \lesssim 20$ eV, $T_i \lesssim 1$ eV can be achieved. All the noble gases as well as hydrogen were used at pressures ranging from 2×10^{-6} to 2×10^{-3} torr. Electron plasma waves and ion acoustic waves were both used for diagnostic purposes. Unless special precautions are taken, the plasma has density fluctuations of 5 to 10%. A feedback control system that uses a rapidly responding adjustment of discharge power was used to significantly reduce these fluctuations. This control will also keep the plasma density steady even in the presence of fluctuations in line voltage or gas feed. (auth) (UK)

25135 LOW-FREQUENCY STREAMING INSTABILITIES IN MAGNETOPLASMAS. Lakhina, G. S.; Buti, B. (Indian Inst. of Tech., Delhi). Phys. Lett.; 34A: 269-70(22 Mar 1971).

The effects of ion motion and ion streaming on transverse instabilities in contrastreaming magnetoplasmas are investigated. The ion-streaming tends to destabilize the system by reducing the value of the critical electron streaming velocity required to excite this instability. The ion temperature, however, shows the stabilizing effect. (auth)

25136 TEORIYA PLAZMENNYKH NEUSTOICHIVOSTEI. TOM I. NEUSTOICHIVOSTI ODNORODNOI PLAZMY. (Theory of Plasma Instability. Volume I. Instability of Uniform Plasmas). Mikhailovskii, A. B. Moscow: Atomizdat (1970). 296p.

Excitation of oscillations during interactions of monoenergetic beams, kinetic instabilities, dynamics of wave packets in unstable plasma wave amplifications, influence of plasma inhomogeneities, and collisions of beam instabilities are covered in the first six chapters. Dielectric penetrability and plasma oscillations in magnetic fields, excitation of plasma oscillations by radially limited and azimuthal electron beams, instabilities of anisotropic plasma with hot electrons, and instabilities of plasma with longitudinal and transverse currents are discussed in the next eight chapters. The last three chapters deal with the excitation of high-frequency and ion-cyclotron oscillations induced by loss cones, the rate of anisotropy of ions, and longitudinal and transverse ion currents present in plasma. (333 references.) (R.V.J.)

25137 STABILITY ANALYSIS OF MAGNETICALLY CONFINED PLASMAS. Sawyer, Gary Allen. Milwaukee; Marquette Univ. (1970). 100p. University Microfilms Order No. 71-5314.

Thesis.

The plasma stability problem is approached using some new extensions of Liapunov stability theory to partial differential equations that have emanated from research on the control of distributed parameter systems. This theory can be applied to a more general model of a thermonuclear plasma than could be used by previous investigators of plasma stability. With this approach, stability criteria for the equilibrium states was obtained for both the linear and nonlinear resistive plasma models. Besides producing results that are much more general than existing criteria, the developed theory indicates possible corrective action. Additional results include the determination of an estimate on transient behavior for the linear model and the region of asymptotic stability for the nonlinear plasma model. The theory is illustrated by an example. (TSS) (Diss. Abstr. Int., B)

25138 PLASMA EQUILIBRIUM AND THERMAL INSULATION IN THE STELLARATOR WITH LOW SHEAR. Burchenko, P. Ya.;

Vasilenko, B. T.; Volkov, E. D.; (and others) (Inst. of Physics and Tech., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 15: 1842-5 (Nov 1970). (In Russian).

Some investigations of plasma thermal insulation in the stellarator Sirius are described. It is shown that in the absence of plasma column equilibrium [$nkT > \beta_e(H_\beta^2/8\pi)$] the plasma energy lifetime τ_E is independent of a magnetic field. At $nkT < \beta_e(H_\beta^2/8\pi)$, τ_E grows with an increase in the magnetic field strength. The measured τ_E values are in rather reasonable agreement with the calculated ones, assuming drift-temperature instability development. (auth)

25139 EXPLOSIVE INSTABILITIES IN THE PRESENCE OF LINEAR DAMPING OR GROWTH. Wilhelmsson, H. (Univ. of Uppsala). Phys. Scr.; 2: 113-15(1970).

The basic system of nonlinear equations governing explosive instabilities is studied for the general case where the interacting modes have mutually different linear damping or growth. (auth) (Sweden)

Thermonuclear Processes

Refer also to abstracts 24845 and 24846.

25140 (IAE-1967) METHOD OF EXPERIMENTAL DETERMINATION OF DEPTH OF MAGNETIC WELL AND STUDY OF PROPERTIES OF SYSTEM WITH MINIMUM B. Glagolev, V. M.; Skosyrev, Yu. V.; Shmarin, A. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Atomnoi Energii). 1970. 18p. (In Russian). Dep. NTIS (U. S. Sales Only).

An experimental method is described for determination of the value of the minimum B in magnetic systems having sectors with known distribution of magnetic field. Results are presented from measurement of the depth of the magnetic well in configurations containing a homogeneous longitudinal field and transverse fields of the first, second, and third azimuthal harmonics. The mean value of the magnetic well was $\Delta H/H = (3 \pm 1.2)\%$. (JPRS)

25141 (MATT-715) FUSE CHARACTERISTICS. Murray, John G.; Bronner, G. (Princeton Univ., N. J. Plasma Physics Lab.). Oct 1970. Contract AT(30-1)-1238. 18p. Dep. NTIS.

For many applications the present standard I^2t rating method for coordinating fuses is not satisfactory. Examples include the protection of solid-state devices without large safety factors, and high-voltage dc circuits. Therefore, an improved engineering and rating procedure for the application engineer is needed for such interrupting devices. A method is suggested for obtaining the arc voltage as a function of the circuit parameters and applying ratings based on this. The procedure is checked against test results for four types of fuses. (auth)

25142 (MATT-801) TRITIUM RECOVERY IN FUSION POWER REACTORS. Johnson, E. F. (Princeton Univ., N. J. Plasma Physics Lab.). Nov 1970. Contract AT(30-1)-1238. 13p. (CONF-700912-10). Dep. NTIS.

From 5. annual intersociety energy conversion engineering conference; Las Vegas, Nev. (21 Sep 1970).

Among the principal advantages claimed for fusion power reactors are low power costs, low hazard operation, and low environmental pollution. These advantages are examined from the standpoint of the tritium processing required in a first-generation fusion power plant. Despite the high initial cost of tritium and its objectionable physiological properties, the tritium processing contributes little to the cost of power or the hazard of operation. In the tightly closed operation essential to the maintenance of the tritium balance, the contribution to pollution of the environment is far below the most stringent likely specification. (auth)

25143 (UCRL-50981) LOW-VOLTAGE SOURCE FOR MOLECULAR ION PRODUCTION. Osher, J. E.; Steinhaus, J. F. (California Univ., Livermore. Lawrence Radiation Lab.). 15 Dec 1970. 11p. Dep. NTIS.

A low voltage test source (LVTS I) developed for neutral beam production on the ALICE Baseball I experiments is described. This relatively small source is designed for 1- to 3-kV operation and is particularly suited to molecular ion production of (H_2^+ or H_3^+). (auth)

25144 (UCRL-72969) THERMONUCLEAR REACTORS, MIRROR MACHINES AND DIRECT CONVERSION. Werner, R. W. (California Univ., Livermore. Lawrence Radiation Lab.). 21 Jan 1971. 62p. (CONF-710109-1). Dep. NTIS.

From Direct energy conversion short course conference; Tempe, Ariz. (25 Jan 1971).

Basic plasma physics principles are reviewed. The main approaches for controlled fusion are briefly described. The use of a direct energy converter in conjunction with magnetic mirrors is described in some detail. The advantages are pointed out. (M.O.W.)

25145 CONCEPTUAL DESIGN OF A FUSION POWER PLANT TO MEET THE TOTAL ENERGY REQUIREMENTS OF AN URBAN COMPLEX. Fraas, A. P. (Oak Ridge National Lab., Tenn.). pp 1-18 of Nuclear Fusion Reactors. London; Inst. of Civil Engineers (1970).

From International Conference on Nuclear Fusion Reactors, Culham, England. See CONF-690901.

For study purposes a conceptual design for a thermonuclear power plant was evolved to meet the total energy requirements of urban complexes in the year 2000. A layout for the plant, including the principal auxiliaries, is presented and some of the more important plant integration problems are discussed. The rapid growth of urbanization and the consequent problems of environmental pollution are outlined, together with the projected total energy requirements of the U. S. for the year 2000. Means for providing both electric power and heat for buildings and industrial processes with an economically attractive system are outlined, together with a preliminary investigation of provisions for distillation of all the sewage from urban complexes. The results of the study show strong incentives to develop high-temperature (~1000°C) rather than low-temperature (~300°F) reactors, fusion rather than fission reactors, and basic designs suitable for economical plants in capacities down to and including 300 MW(e), rather than very large plants. (auth) (UK)

25146 ECONOMIC FACTORS AFFECTING RESEARCH INTO FUSION POWER. Searby, P. J.; Brookes, L. G. (United Kingdom Atomic Energy Authority, London). pp 20-9 of Nuclear Fusion Reactors. London; Inst. of Civil Engineers (1970).

From International Conference on Nuclear Fusion Reactors, Culham, England. See CONF-690901.

The economic case for fusion power development rests on the benefits to the economy that the successful exploitation of a fusion reactor could bring. The main such benefit is a reduction in electricity costs, and the size of the benefit depends on the demand for electricity and the differential advantage of fusion reactors as compared with the next best alternative. This paper considers possible capital and fuel costs of systems that might be developed, examining the relative importance of capital and fuel costs against the possible range of load factors that might be experienced during their lifetimes by large power stations installed at the end of the century. (auth) (UK)

25147 NUCLEAR FUSION OBJECTIVES. Tuck, J. L. (Los Alamos Scientific Lab., N. Mex.). pp 31-40 of Nuclear Fusion Reactors. London; Inst. of Civil Engineers (1970).

From International Conference on Nuclear Fusion Reactors, Culham, England. See CONF-690901.

The argument is developed that nuclear energy is essential to the future of mankind, and it is shown that fusion energy would have substantial advantages over fission. Although fusion power is somewhat slower to come than had been promised, there are now two or three plasma heating and confinement systems that have reached thermonuclear temperatures and densities close to those needed for a reactor. (UK)

25148 FISSION-FUSION SYMBIOSIS: GENERAL CONSIDERATIONS AND A SPECIFIC EXAMPLE. Lidsky, L. M. (Massachusetts Inst. of Tech., Cambridge). pp 41-53 of Nuclear Fusion Reactors. London; Inst. of Civil Engineers (1970).

From International Conference on Nuclear Fusion Reactors, Culham, England. See CONF-690901.

The concept of a hybrid fission–fusion nuclear power plant is described, and its advantages over a simple system are discussed. The expensive development of fast breeder systems could be curtailed, and developments in fusion technology could be incorporated as they arose. (UK)

25149 FUSION REACTORS AND ENVIRONMENTAL SAFETY. Morley, F.; Kennedy, J. W. (United Kingdom Atomic Energy Authority, Harwell, Eng.). pp 54-65 of Nuclear Fusion Reactors. London; Inst. of Civil Engineers (1970).

From International Conference on Nuclear Fusion Reactors, Culham, England. See CONF-690901.

Calculations are described that provide an indication of the limits within which tritiated effluent discharges will have to be controlled and the scale of accident which would be of radiological importance. The results of these calculations are then used to estimate the standard of tritium containment which will have to be

achieved in fusion reactor design and operation. Finally, a brief comparison is drawn with environmental contamination resulting from power production by fission reactors. (auth) (UK)

25150 MIRROR REACTORS: SOME GENERAL CONSIDERATIONS. Sweetman, D. R. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). pp 112-21 of Nuclear Fusion Reactors. London; Inst. of Civil Engineers (1970).

From International Conference on Nuclear Fusion Reactors, Culham, England. See CONF-690901.

A review of the problems associated with the mirror machine as a reactor is presented, and basic energetic and economic considerations of mirror systems are discussed. (UK)

25151 GEOMETRY OF A MINIMUM-B REACTOR. Cordey, J. G.; Watson, C. J. H. (Culham Lab., Abingdon, Eng.). pp 122-43 of Nuclear Fusion Reactors. London; Inst. of Civil Engineers (1970).

From International Conference on Nuclear Fusion Reactors, Culham, England. See CONF-690901.

In designs of a thermonuclear reactor based upon magnetic mirror confinement it is normally assumed that the minimum-B principle will be used to ensure the MHD stability of the plasma and that a high mirror ratio R will be used to minimize end losses. In this paper it is shown that, even when the geometry of the magnetic field is arranged to combine these two features in an optimum manner, a heavy economic penalty is involved; typically the capital cost of the superconducting windings used to maintain such a magnetic field would exceed the corresponding cost for a simple mirror with the same thermonuclear output by a factor of order $R\nu/2\nu\ (1-\beta)\ \nu/2$ where $\beta = 8\pi p_{\perp}/B^2$ and ν is a cost index in the range 2 to 4. The optimization used in this assessment takes into account both the enhancement of the mirror ratio due to the presence of a plasma of finite β and the restriction upon the design of the magnetic field imposed by the Taylor–Hastie finite-β MHD stability criterion, which has been proved to be applicable to systems with large mirror ratio. (auth) (UK)

25152 FUSION REACTORS AND PLASMA FLOW. Newton, A. A. (Culham Lab., Abingdon, Eng.). pp 182-93 of Nuclear Fusion Reactors. London; Inst. of Civil Engineers (1970).

From International Conference on Nuclear Fusion Reactors, Culham, England. See CONF-690901.

Reactors using plasma flow to heat and compress plasma have geometry similar to the Dense Plasma Focus or Marshall Coaxial Gun with a focused plasma column, which forms on the axis in front of the center electrode and extends for a considerable length. This extension may be obtained with a guide field. The plasma is flowing away from the gun and the pinch is sustained by the convection of cold plasma from the interelectrode cavity. Assuming the simplest model of plasma flow, ideal stability, and favorable technological factors, one can calculate to an order of magnitude the conditions necessary to meet the revised Lawson criteria. The initial density, current, and power output can be specified in terms of the aspect ratio (plasma length to electrode radius), compression ratio (density increase during flow), current fraction (ratio of current used for confinement of the column to the total current) and the initial radius. Flow reactors have several novel features, and possible advantages compared with steady-state reactors are discussed; in particular, the plasma handling problem appears to be simpler in the former. (auth) (UK)

25153 TOKAMAK AS A POSSIBLE FUSION REACTOR: COMPARISON WITH OTHER CTR DEVICES. Golovin, I. N. (Inst. of Atomic Energy, Moscow); Dnestrovskii, Yu. N.; Kotomorov, D. P. pp 194-220 of Nuclear Fusion Reactors. London; Inst. of Divil Engineers (1970).

From International Conference on Nuclear Fusion Reactors, Culham, England. See CONF-690901.

The parameters of a laboratory Tokamak, used in this paper for comparison, are given. Some of these parameters have to be increased by a factor of several hundred to design an industrial unit and, to do this, a series of developing experiments whose parameters gradually reach those of a reactor must be constructed. The development of theory corroborated by experiment is increasing continuously. Some numerical solutions arising from such development are given. These are of importance in the prediction of the ways of development of nuclear fusion investigations. Comparison is made with the stellarator and mirror machines. It is shown that the Tokamak has the only advantage that, by increasing the power cost or trying to raise the hydrodynamic stability of the plasma there are clear indications on how to improve the confinement, while for mirror machines the possibility of improving the confinement is less clear. However, eventually the situation may change in favor of mirror machines. Stellarators are duplicating the direction of the work and there is no reason not to continue studying them. (UK)

25154 THERMONUCLEAR FUTURE OF THE TOKAMAK MAGNETIC CONFINEMENT DEVICE. Hubert, P. (Centre d'Etudes Nucleaires, Fontenay-aux-Rose, France). pp 222-32 of Nuclear Fusion Reactors. London; Inst. of Civil Engineers (1970).

From International Conference on Nuclear Fusion Reactors, Culham, England. See CONF-690901.

An eventual extrapolation of the Tokamak principle towards a thermonuclear reactor raises many problems in which stress is laid on the minimum values required for the equilibrium and stability parameters. Some technological requirements are considered, together with the most recent theoretical developments, and reveal the existence of a small domain inside of which both points of view may be, perhaps, simultaneously satisfied. The operation of the reactor would have to be discontinuous, but each cycle might conceivably include a plateau lasing about 10^3 sec. A major difficulty arises from the necessity to develop a heating method with an efficiency amounting to at least a few 10^{-3}, keeping in mine other requirements that are technologically difficult. (auth) (UK)

25155 PERMISSIBLE PARAMETERS FOR ECONOMIC STELLARATOR AND TOKAMAK REACTORS. Gibson, A. (Culham Lab., Abingdon, Eng.). pp 233-41 of Nuclear Fusion Reactors. London; Inst. of Civil Engineers (1970).

From International Conference on Nuclear Fusion Reactors, Culham, England. See CONF-690901.

The principal objective of present-day fusion research is to devise and investigate efficient traps for thermonuclear plasmas. The outcome of this research will determine the size and complexity of a fusion reactor; the economy of the reactor will be largely determined by the ratio of plasma to magnetic pressure (β), for which acceptable containment can be achieved. It cannot be predicted what this critical value of β will be, but it is possible to place a likely upper limit to it in particular types of trap. Theoretical estimates are available of the maximum β for which toroidal equilibria can exist and for which these equilibria would be stable if the plasma were a perfectly conducting fluid. A plausible value for this upper limit is obtained from published theory, and the restrictions implied for a reactor are examined. (auth) (UK)

25156 FEASIBILITY STUDIES OF PULSED, HIGH-β FUSION REACTORS. Bell, G. I.; Borkenhagen, W. H.; Ribe, F. L. (Los Alamos Scientific Lab., N. Mex.). pp 242-53 of Nuclear Fusion Reactors. London; Inst. of Civil Engineers (1970).

From International Conference on Nuclear Fusion Reactors, Culham, England. See CONF-690901.

In a previous report (1966) the feasibility of obtaining an energy balance in a reactor having $\beta = 1$ plasma contained by a pulsed magnetic field B_z was studied. Energy balance was found to occur at approximately $n\tau = 5 \times 10^{14}$ cm^{-3} sec for $B_z = 200$ kG, plasma radius $R_p = 5$ cm, and coil inner radius $R_c = 10$ cm. In the present report the original treatment is elaborated as follows: (1) The copper coil inside the neutron moderating blanket is relieved of the magnetic hoop stress by backing it with a Mo-alloy structure; (the Cu largely excludes B_z from the Mo). (2) The effect of the Mo structure and other flow-channeling structures on the triton production in the Li blanket is studied. (3) Coil heating due to the following energy sources is calculated: (i) joule heat, (ii) nuclear recoil and charged-particle energy deposition, largely from (n,p) and (n,n'p) reactions from primary neutrons, (iii) γ rays from nonelastic scattering of primary and blanket-moderated neutrons, and (iv) γ rays from neutrons captured in the blanket and coil. (4) Heat-transfer cycles involving steam and helium to cool the coil and Mo backing are calculated. (5) An analytical energy balance including all these factors is given. The properties of a net-power-producing reactor at 5000 MW(e), including its direct conversion power, are given. (auth) (UK)

25157 PULSED FUSION REACTOR BASED ON THE TOROIDAL PINCH. Bodin, H. A. B.; James, T. E.; Newton, A. A. (Culham Lab., Abingdon, Eng.). pp 255-67 of Nuclear Fusion Reactors. London; Inst. of Civil Engineers (1970).

From International Conference on Nuclear Fusion Reactors, Culham, England. See CONF-690901.

The possibility of building a reactor based on a system in which the plasma is confined by means of a combination of axial (B_z) and azimuthal (B_θ) magnetic fields is discussed, the latter being produced by a current flowing in the plasma around the major axis of the torus. Such systems have the simplicity associated with axisymmetry and the shear is generated by plasma currents, which can also be used to heat the gas. However, because the axial current must be induced by transformer action these systems are

necessarily pulsed. Two varieties of pulsed systems are considered, the purely pulsed system where the pulse length approximates the burnup time, typically 5 to 10 seconds, and the quasi-steady-state system, in which the pulse can be many tens of seconds or more. This has advantages in terms of energy balance, but requires continuous refueling and a divertor system. If these problems can be solved, quasi-steady operation is likely to be best. (auth) (UK)

25158 FEASIBILITY STUDIES OF PULSED TOROIDAL REACTORS. Butt, E. P. (Culham Lab., Abingdon, Eng.). pp 268-81 of Nuclear Fusion Reactors. London; Inst. of Civil Engineers (1970).

From International Conference on Nuclear Fusion Reactors, Culham, England. See CONF-690901.

The encouraging experimental results obtained from ZETA and Tokamak, particularly during the period of approximately constant current, have suggested that configurations of this type might form a basis for fusion reactors in the future. Studies were made of the feasibility of toroidal pinch reactors and the factors that influence their cost. Such reactors would necessarily be pulsed so that they would differ significantly from the continuously operated reactor concept. Attention is concentrated on the plasma parameters required for the different variants of pinch reactor, using currently accepted technical parameters, with a view to assessing the feasibility of each type by the use of model plasma configurations that approximate, as closely as possible, the available experimental results. (auth) (UK)

25159 SOME DESIGN ASPECTS OF THE FIELD SYSTEM AND ASSOCIATED POWER SUPPLY OF PULSED TOROIDAL FUSION REACTORS. James, T. E.; Newton, A. A.; Bodin, H. A. B. (Culham Lab., Abingdon, Eng.). pp 282-304 of Nuclear Fusion Reactors. London; Inst. of Civil Engineers (1970).

From International Conference on Nuclear Fusion Reactors, Culham, England. See CONF-690901.

Some estimates are given of the cost and efficiency of producing the pulsed power supply necessary to provide the magnetic and plasma energy associated with the large axial current induced in the plasma to provide initial plasma heating and a proportion of the confining magnetic field. Comparisons of various types of pulsed power supplies shows that rotating machines, inductive storage systems, and capacitor banks all have sufficiently low losses to give the required electrical output and that, with the first two, economic operation appears to be possible. If, on the other hand, an inductive storage system with a high proportion of energy recovery is both feasible and cheap, this should prove to be the most economic and reliable power supply. (UK)

25160 FUEL BURNUP AND DIRECT CONVERSION OF ENERGY IN A D–T PLASMA. Oliphant, T. A. (Los Alamos Scientific Lab., N. Mex.). pp 306-21 of Nuclear Fusion Reactors. London; Inst. of Civil Engineers (1970).

From International Conference on Nuclear Fusion Reactors, Culham, England. See CONF-690901.

A detailed study of the processes taking place in the thermonuclear plasma as the fuel is being consumed is given. As a result of the D–T reaction, alpha particles of energy 3.52 MeV are produced. Because of the relatively high energy of these alphas, they produce a noticeable increase in pressure while their density is still small relative to that of the fuel plasma. As the alphas are produced they are thermalized by the colder, more dense fuel plasma and this tends to inhibit the above mentioned pressure increase. On the other hand, the fuel plasma gets heated by the alphas and this tends to enhance the pressure increase. The net result is an expansion of the plasma against the confining field and the resulting work done on the external electrical system. In this process some of the energy released in the thermonuclear reaction is converted directly into useful work. The theoretical investigation described consists of numerically solving the Fokker–Planck equation for the time-dependent distribution functions and presenting the relevant physical information that can be obtained from them. (auth) (UK)

25161 TIME-DEPENDENT BEHAVIOUR OF FUSION REACTORS. Mills, R. G. (Princeton Univ., N. J.). pp 322-35 of Nuclear Fusion Reactors. London; Inst. of Civil Engineers (1970).

From International Conference on Nuclear Fusion Reactors, Culham, England. See CONF-690901.

If a deuterium–tritium plasma of about 10 keV or higher temperature can be produced and confined under conditions such that the product of the ion density, n_i, and the confinement time, τ, is of the order of 10^{14} to 10^{15} sec cm^{-3}, it will be physically possible to produce a nuclear fusion chain reaction. A machine proposed as a reactor making use of plasma confinement may fall into one of four categories, depending on the value of the $n_i\tau$ product. If this is below a certain limit (the Lawson criterion) no net-energy-producing reactor is possible. If $n_i\tau$ is greater than this value but less than another (the equilibrium condition), a reactor is possible, but a continuous supply of energy from outside is necessary to maintain the reaction. If $n_i\tau$ is equal to a specific value, the reactor may have cold fuel injected in equilibrium with diffusive losses, and the ion and electron temperatures are constant in time. If $n_i\tau$ exceeds this value, electron temperature runaway will occur and only pulsed reactors are possible. A reactor operating at the equilibrium condition should result in the simplest system and therefore be the most economic type. However operation at this condition is complicated in most cases by the instability of the equilibrium; thus feedback control may be necessary for a fusion reactor. The equilibrium condition fixes other significant quantities such as the percent burnup of fuel per pass through the machine and the density and relative pressure of helium nuclei in the plasma. The power required for the ignition of a thermonuclear plasma may be an important consideration for the design and economy of a plant. This power may be excessive unless the confinement time decreases as the plasma density rises, preferably in inverse proportion. Computer codes have been written to follow, in time, the development of a high-temperature reactive plasma. By use of these codes the above-mentioned effects may be clearly demonstrated. A variety of these results are presented. (auth) (UK)

25162 ENGINEERING PARAMETERS OF A FUSION REACTOR. Carruthers, R. (Culham Lab., Abingdon, Eng.). pp 337-47 of Nuclear Fusion Reactors. London; Inst. of Civil Engineers (1970).

From International Conference on Nuclear Fusion Reactors, Culham, England. See CONF-690901.

The form a fusion reactor might take, based on the present plasma containment studies, is reviewed. Some technological problems to be faced in realizing such a reactor are outlined. It is concluded that, for a fusion reactor based on the D–T cycle, the minimum dimension is determined by engineering factors quite separate from any consideration of the plasma; these engineering factors identify the plasma parameters that must be achieved for a fusion reactor to be economical. To compete with the cost of other methods of power generation, a fusion reactor will have an output in excess of 100 MW(t) per meter length to a high unit rating for closed line devices. There are many challenging technological problems to be tackled before the demonstration of an adequately contained, high-temperature plasma can be translated into a power-producing reactor. Possible solutions to these problems have already been identified that are encouraging. (UK)

25163 ION BURIAL IN THE DIVERTOR OF A FUSION REACTOR. McCracken, G. M.; Erents, S. K. (Culham Lab., Abingdon, Eng.). pp 353-62 of Nuclear Fusion Reactors. London; Inst. of Civil Engineers (1970).

From International Conference on Nuclear Fusion Reactors, Culham, England. See CONF-690901.

In any steady-state fusion reactor the flux of energetic ions diffusing from the plasma must be extracted. The ion flux will consist primarily of the deuterium and tritium fuel, which has to be reinjected, along with the helium-ion product of the reaction, which will depend directly on reactor burnup but is likely to be about 5% of the total ion flux. Methods of extracting the ions from the plasma containment vessel by means of a magnetic divertor have been developed in contemporary experiments. The present study determines whether a useful fraction of the flux of ions can be effectively pumped in the divertor by ion burial in a solid or liquid target and examines the implication of the measurements made of the trapping of deuterium ions in lithium. A possible scheme for the operation of a divertor, using some of the conclusions of this paper, is presented. (UK)

25164 ASSESSMENT OF SOME RADIATION DAMAGE EFFECTS IN THE CONTAINMENT VESSEL OF A THERMONUCLEAR REACTOR. Martin, D. G. (Atomic Energy Research Establishment, Harwell, Eng.). pp 399-409 of Nuclear Fusion Reactors. London; Inst. of Civil Engineers (1970).

From International Conference on Nuclear Fusion Reactors, Culham, England. See CONF-690901.

An assessment of the effects of neutron irradiation on the containment vessel of a fusion reactor was attempted. The vessel was assumed to be constructed of niobium and after 20 years to have received a dose of 2.3×10^{23} 14-MeV neutrons/cm^2. Temperatures over the range 600 to 1200°C were assumed. Transmutation reactions result in the formation of about 0.5, 0.28, 0.6 and 10 at. % of hydrogen, helium, yttrium, and zirconium, respectively, after 20

years. The effect these formations will have are discussed. Assessment of the effects due to atomic displacement is more difficult. Low-dose experiments predict that, at irradiation temperatures above about 650°C, there should be little change in the yield stress of niobium. However, at high doses changes may occur, as in stainless steels. Predictions are made about the radiation-enhanced steady-state creep formation of voids in niobium. Two surface effects relating to neutron damage of the containment vessel are considered: the evaporation of atoms from thermal spikes created by neutron collisions close to the surface and the migration of helium and hydrogen atoms to the surface. Both effects are shown to result in a negligible contamination of the plasma. (UK)

25165 FUSION TORCH: UNIQUE APPLICATIONS OF ULTRA-HIGH TEMPERATURE PLASMAS. Eastlung, B. J.; Gough, W. C. (Atomic Energy Commission, Washington, D. C.). pp 410-22 of Nuclear Fusion Reactors. London; Inst. of Civil Engineers (1970).

From International Conference on Nuclear Fusion Reactors, Culham, England. See CONF-690901.

The fusion torch concept opens up the possibility of closing the basic link from use back to resource. Waste products could be converted back to elemental form, thus simultaneously eliminating the problem of the disposal of the waste product while providing a supply of basic raw materials. When fusion reactors are available, volume of materials equal to thousands of tons per day could be handled in a single plant. The handling of urban wastes then becomes a possibility. If just 10,000 MW were used for processing via the fusion torch, the entire wastes of a city with a population in the millions could be converted back into raw materials each day. Using engineering modification of existing plasma generators, specific applications such as ore reduction, alloy separation, and plastics elimination could be considered. Using already-developed technology, kilowatt and megawatt sources of ultraviolet energy could be applied to any of the current uses of such energy, e.g., sterilization and photolysis. Thus, the fusion torch concept not only offers the potential of overcoming urgent future problems of raw materials and pollution, but offers the possibility for the immediate application of the ultrahigh-temperature plasmas developed under fusion research. (UK)

25166 SOME TOPICS ON PULSED SYSTEMS AND MIRRORS. Rose, D. J.; Flint, G. L. Jr.; Marcus, F. B. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-3980. pp 429-39 of Nuclear Fusion Reactors. London; Inst. of Civil Engineers (1970).

From International Conference on Nuclear Fusion Reactors, Culham, England. See CONF-690901.

An analysis of pulsed fusion systems indicates that operation for about 0.1 sec at 10 tesla in a device approaching 1-m diameter may be most feasible. Such parameters are not far from those of proposed steady-state devices and are arrived at from studying properties of materials. A titanium–zirconium–molybdenum (TZM) coil appears most nearly satisfactory, taking into account tritium breeding, simple hoop stress, vacuum wall heating, and thermal stress. Energy balance in a steady-state mirror is affected by details of alpha-particle slowing down and by loss of synchrotron radiation. It appears that, if the mean α-slowing-down time and lifetime are estimated correctly, the alpha-heating will be approximately correctly estimated. Seriousness of synchrotron radiation loss and limitation of electron temperature to about 40 keV are confirmed by calculations made more consistently than hitherto. From these facts and others it is concluded that obtaining favorable energy balance in mirrors is becoming even more difficult. (auth) (UK)

25167 OVERALL TRITIUM BALANCES IN FUSION REACTORS. Johnson, E. F. (Princeton Univ., N. J.). pp 441-8 of Nuclear Fusion Reactors. London; Inst. of Civil Engineers (1970).

From International Conference on Nuclear Fusion Reactors, Culham, England. See CONF-690901.

The tritium inventory required for the startup of the first power reactor is examined. Since the initial inventory must come from outside sources likely to be very expensive, it must be as low as possible. The likely total initial tritium requirements for a stellarator having a reasonable power output of 2 GW(e) are considered, and it is thought reasonable to expect that it should be able to start up with an initial tritium stockpile of less than 2 kg. Furthermore, at $1.00 per KW(e), the total capital investment in tritium-processing equipment in the machine is less than 1% of the total plant investment. (UK)

25168 NEUTRONICS CALCULATIONS FOR BLANKET ASSEMBLIES OF A FUSION REACTOR. Blow, S.; Crocker, V. S.; Wade, B. O. (Atomic Energy Research Establishment, Harwell, Eng.). pp 492-501 of Nuclear Fusion Reactors. London; Inst. of Civil Engineers (1970).

From International Conference on Nuclear Fusion Reactors, Culham, England. See CONF-690901.

Two types of design investigated by Steiner (ORNL-TM-2360, 1968), type A, an optimistic design based on exclusive use of lithium as coolant, and type B, in which flibe was introduced into various regions of the blanket, were examined for tritium production and neutron absorption and multiplication in the various retions of the blanket. It is concluded that adequate tritium breeding may be achieved in a blanket 100-cm thick, so long as liquid lithium may be used as coolant in a number of interior regions. It is not necessary to use expensive beryllium for neutron multiplication and moderation. If flibe has to be used exclusively as coolant there will be few extra neutrons available to enhance the power density in the inner-blanket regions. At the same time the heating rate in the first wall is increased because of γ-ray backshine from inelastic scattering in fluorine. Both of these conditions would be deleterious to the economic operation of a fusion power reactor. (UK)

25169 HALL ACCELERATORS IN FUSION RESEARCH. Cole, H. C. (Culham Lab., Abingdon, Eng.). pp 503-16 of Nuclear Fusion Reactors. London; Inst. of Civil Engineers (1970).

From International Conference on Nuclear Fusion Reactors, Culham, England. See CONF-690901.

The basic characteristics of a plasma injection system are examined, and the importance of injector efficiency is assessed. The problem of injection, both into experimental and into reactor systems, is considered, with particular reference to Hall accelerators. A modified design of a Hall accelerator that may provide direct injection into stellarators is described, and preliminary results obtained from a prototype are presented. Suggestions are made on future lines of development. While the work is aimed specifically at stellarator systems, much of what is said applies to other geometries. (auth) (UK)

25170 FUSION REACTOR IGNITION USING RF POWER. Wort, D. J. H. (Culham Lab., Abingdon, Eng.). pp 517-21 of Nuclear Fusion Reactors. London; Inst. of Civil Engineers (1970).

From International Conference on Nuclear Fusion Reactors, Culham, England. See CONF-690901.

The reactor ignition problem is considered from the point of view of heating an initially cool plasma to thermonuclear temperatures in a closed confinement system (stellarator or Tokamak), and it is considered that transit-time magnetic pumping (TTMP) is the only method that can meet the requirements. It is concluded that, provided an initial plasma with temperature above about 1 keV can be obtained in a reactor system, it would be technically feasible to attain thermonuclear conditions using TTMP. The input power, amounting to some hundreds of megawatts for the reactors currently being discussed, would be applied as a low radiofrequency (~100 kHz) voltage to an array of coils surrounding the plasma to produce a modulation of the confining field. The efficiency of this system should be over 50% of the applied power being absorbed by the plasma. This pumping method would also permit a gradual startup of the reactor with consequent reduction in the thermal shock. (UK)

25171 DIRECT HELIUM-COOLING CYCLE FOR A FUSION REACTOR. Hopkins, G. R.; Melese-d'Hospital, G. (Gulf General Atomic Inc., San Diego, Calif.). pp 522-35 of Nuclear Fusion Reactors. London; Inst. of Civil Engineers (1970).

From International Conference on Nuclear Fusion Reactors, Culham, England. See CONF-690901.

Helium technology is now available for high-temperature gas-cooled fission reactors, and coupling with a direct cycle gas turbine is now under development. The same direct helium cycle appears feasible for cooling the blanket and even the vacuum wall region of a fusion reactor. With a 10-m-diameter plasma, 345 MW(t) are produced per meter of length. Blanket sections from 3 to 9 m could be cooled by 50- to 20-atm helium with a mixed mean outlet temperature of 965°C at net cycle efficiencies up to 50%. (auth) (UK)

25172 REVIEW ON THE RESEARCH AND DEVELOPMENT OF NUCLEAR FUSION. Yamamoto, Kenzo (Nagoya Univ., Japan); Mori, Shigeru. Genshiryoku Kogyo; 16: 138-43(Apr 1970). (In Japanese).

The nuclear fusion reactor has many attractive features such as high economy, remarkable safety, and abundance of fuel. Re-

search and development on nuclear fusion are described for the following: problems in nuclear fusion, including the realization of zero-power reactor conditions, etc.; the Bohm time overcome, dealing with the case of a multipole toroidal device; revival of the Tokamak toroidal containment device; trend in the open-ends system, dealing with the mirror and the theta-pinch type; a nuclear fusion device; and prospects for the 1970's. (Japan)

25173 EXPLOSIVELY DRIVEN FAST ACTING HIGH CURRENT CROWBAR SWITCH. Hornady, R. (Univ. of Maryland, College Park). Rev. Sci. Instrum.; 42: 538-9(Apr 1971).

The switch described utilizes the electric primer manufactured by Winchester Western for use in the USAF ARD446/463 weapons. The stored chemical energy (0.10 to 0.13 g of tetracene) supplies approximately 200 J to a 5.4 g rivet to close the contact between two electrically insulated copper plates. The rivet closes the contact in 0.15 msec with jitter time of approximately 10 μsec. When the contact set and rivet are cleaned of oil and oxides, there is no evidence of arcing at the highest available currents (25 kA). The measured contact resistance is less than 10^{-4} Ω. The input impedance of the primer firing circuit is 1.0 to 1.2 Ω and the primer is designed to detonate in less than 1 msec when 10 V is applied. In the present experiment, a 0.1 μF capacitor charged to 3 kV is used to detonate the primer. (M.O.W.)

Wave Phenomena

Refer also to abstracts 24977 and 24996.

25174 PLASMA ECHO AND SPIN ECHO HOLOPHONES. Watson, C. J. H. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Nature (London); 229: 28-30(1 Jan 1971).

It is shown that collisionless plasma, or an assembly of nuclear or electron spins in a magnetic field, can function as a holophone which can record a temporal sequence of electrical signals and subsequently play them back when supplied with a cue sequence, consisting of a small part of the recorded sequence. (auth) (UK)

25175 NONLINEAR INTERACTION BETWEEN CIRCULARLY POLARIZED WAVES AND ELECTRON PLASMA WAVES. Kim, H.; Harker, K. J.; Crawford, F. W. (Stanford Univ., Calif.). J. Appl. Phys.; 42: 1997-2005(Apr 1971).

A general analysis was made of nonlinear three-wave interactions in a hot magnetoplasma between circularly polarized waves propagating at small angles to the static magnetic field and electron plasma (Langmuir) waves propagating parallel. First, the coupled mode equations are derived by iterative solution of the Vlasov equation. Simplified expressions for the coupling coefficients are then obtained for all of the wave combinations for which the frequency and wave number synchronism conditions can be satisfied, and the wave coupling coefficients are nonzero. These comprise interactions among three right-hand polarized waves, two circularly polarized waves and one Langmuir wave, and three Langmuir waves. The paper concludes with a brief discussion of the specific cases most likely to be worth subjecting to detailed numerical analysis. (auth)

25176 QUANTUM KINETIC EQUATION FOR ELECTRON OSCILLATIONS IN A WEAKLY IONIZED PLASMA. Willett, Joseph E.; Warner, David C.; Fisher, David M. (Univ. of Missouri, Columbia). J. Appl. Phys.; 42: 2005-13(Apr 1971).

A quantum kinetic equation is derived for the free electrons of a weakly ionized plasma in the presence of a space–time-dependent longitudinal electric field. The derivation is based on a one-electron density matrix formalism with scattering by neutral particles treated in the first Born approximation. A systematic procedure for averaging over the random distribution of fixed scattering centers is employed to avoid the criticism of previous methods. The collisional damping decrement for electron electrostatic oscillations is obtained in the classical limit to second order in the wave number. (auth)

25177 GENERATION OF THE SECOND HARMONIC IN INHOMOGENEOUS MAGNETOACTIVE PLASMA. Musil, J.; Zacek, F. (Inst. of Plasma Physics, Prague). Czech. J. Phys.; 21: 148-52(1971).

An experimental study was made of conditions under which the second harmonic of a strong electromagnetic wave generating a spatially inhomogeneous plasma originates and exists. The second harmonic was detected by means of a hf probe inside the plasma and by a horn antenna outside the plasma. It was found that the beginning of generation of a strong second harmonic signal inside the plasma coincides with the overcoming of an evanescent layer and the free passage of the right-hand circularly polarized wave into an inhomogeneous plasma. Dependences of the second harmonic amplitude on the static magnetic field and the gas pressure are given. (auth)

25178 MAGNETOHYDRODYNAMIC INSTABILITY OF A PLASMA WITH ANISOTROPIC PRESSURE. I. DISPERSION EQUATION. Vasiu, Mircea. Stud. Univ. Babes-Bolyai, Ser. Phys.; 15: 87-93(1970). (In French).

The dispersion equation is deduced for an infinite, homogeneous, compressible, nonviscous plasma model provided with a finite electric conductivity and an anisotropic pressure. The electrical displacement current, the thermal conductivity process, the radiation transfer process, and the rotation movement of the plasma are neglected. The small perturbation method is used in the calculation. The results obtained by Chew, Goldberger, and Low are used, and a more general dispersion equation is obtained than that obtained by Tandon and Talwar. They used an infinite, homogeneous, compressible plasma model with an infinite electric conductivity and anisotropic pressure and excited by a rotational motion. (tr-auth)

25179 NONLINEAR INTERACTION OF BERNSTEIN MODE IN BEAM–PLASMA SYSTEM. Idehara, Toshitaka (Fukui Univ., Japan). Fukui Daigaku Kogakubu Kenkyu Hokoku; 18: No. 1, 57-67(Mar 1970).

When the Bernstein mode is excited in a magnetoplasma penetrated by a gyrating electron beam, it is observed that the harmonics of this mode are produced due to the nonlinear interaction. Observations were made of the spatial behavior of fundamental and harmonic waves along axial and radial directions for various beam intensities, the diffusion of plasma across the magnetic field, and the frequency power spectrum of the fundamental and its harmonics. It was verified from these observations, that for the fairly intense electron beam, the Bernstein mode grows exponentially along the magnetic field (linear state), reaches its saturation level together with the generation of the harmonics confined in the beam–plasma region (nonlinear state), and then these waves decay, their spectra are broadened, and the system moves to a turbulent-like state with the diffusion of ions. (auth) (Japan)

25180 COLLISIONAL EFFECTS ON WAVES IN A MAGNETOPLASMA. Howell, John Quayle. Stanford, Calif.; Stanford Univ. (1970). 164p. University Microfilms Order No. 71-2775. Thesis.

A new class of collision-dependent electron waves is found in a non-Maxwellian Lorentz magnetoplasma, and it is shown that these waves may be driven unstable by electron–neutral collisions. The Boltzmann equation with collision integral is solved, assuming propagation either parallel or perpendicular to the magnetic field. Both conductivity tensors are derived and put in a form useful for numerical calculations. The full set of Maxwell's equations is then used to derive the dispersion relations for both directions of propagation. The dispersion relations are initially solved for a monoenergetic electron distribution function and following that a distribution with a peak of nonzero half-width is treated. Some consideration is also given to a Maxwellian distribution both with and without a bump on the tail. As an example of propagation parallel to the magnetic field, transverse electromagnetic or whistler waves are considered. A new collisional mode is found with frequency near the electron cyclotron frequency, and under appropriate conditions it may be either convectively or absolutely unstable. For propagation perpendicular to the magnetic field, longitudinal or electrostatic waves are considered. A series of new collisional modes with real frequency near zero and near multiples of the electron cyclotron frequency are shown to be unstable under some conditions. For both directions of propagation a requirement for instability is that there be present a large-enough proportion of electrons in a region of velocity space where the electron–neutral collision frequency increases (or decreases) rapidly enough. The requirement on the electron–neutral collision frequency is easily met by nitrogen, mercury, and the Ramsauer gases. (Diss. Abstr. Int., B)

25181 COMPUTATION OF THE RANGE OF CYCLOTRON RESONANCES OBSERVED IN THE SCATTERING CROSS SECTION OF A VISIBLE WAVELENGTH BY A PLASMA. Meyer, Rene-Luc; Leclert, Gerard (Univ., Nancy). Compt. Rend., Ser. B; 272: 359-61(8 Feb 1971). (In French).

The cross section for the scattering of a particular visible wavelength by a plasma in a magnetic field was computed for the case when the spectrum of the scattered radiation is composed of peaks at the harmonics of the electron gyrofrequency. The conditions under which the amplitude of the various harmonics exceeds a given value are determined; the existence of an optimum value of the magnetic field is demonstrated. (auth) (France)

XUM

25182 CYCLOTRON OSCILLATIONS OF DENSE PLASMA. Timofeev, A. V. At. Energ. (USSR); 30: 270-4(Mar 1971). (In Russian).

Unstable oscillations are classified from the point of view of the physical processes leading to buildup. The character of evolution of the oscillations in the process of their propagation in the magnetic field is considered. It is shown that unstable oscillations with negative energy are absolute. At the end points of the system the convective oscillations transform into the negative energy oscillations. Such oscillations are destabilized as a result of absorption of energy at these points, therefore, shortening the system will not give positive results, contrary to expectations expressed in a number of papers. It is shown that the cyclotron oscillations in sufficiently dense plasma become nonpotential. The nonpotentiality decreases the increments but does not lead to full stabilization. (auth)

25183 EXCITATION AND STABILIZATION OF ION ACOUSTIC WAVES IN AN RF PLASMA. Okamoto, Y.; Tamagawa, H. (Nagoya Univ., Japan). Plasma Phys.; 13: 71-3(Jan 1971).

Collective interaction between plasma particles in ion acoustic waves is known to cause Landau demping or Landau growth. In order to study Landau growth it is necessary to have a plasma with a special velocity distribution function such as a double-humped one. Experimental confirmations about the relations between ionic energy distribution functions and ion acoustic waves in an rf plasma are described. (auth) (UK)

25184 TIME-OF-FLIGHT STUDY OF WAVES GUIDED BY A PLASMA COLUMN. Demokan, O. (Univ. of Iowa, Iowa City); Hsuan, H. C. S.; Lonngren, K. E. Plasma Phys.; 13: 29-32 (Jan 1971).

An experiment is described for measuring the group velocity of waves guided by a plasma column. Using very short high frequency sine wave burst signals, a time-of-flight experiment was performed. The dependence of the group velocity on $\langle\omega_{pe}(r)\rangle$ was directly obtained. (auth) (UK)

25185 STABILIZATION MECHANISM FOR THE ION ACOUSTIC INSTABILITY. Krishan, S.; Selim, A. A. (Univ. of Alberta, Edmonton). Phys. Lett.; 34A: 287-8(22 Mar 1971).

A nonlinear correction to the linear and nonlinear Landau damping is found. The correction is due to the nonresonant wave–particle interaction of the ions and the electrons with the spectrum. The growth rates vanish as soon as the wave energy reaches a critical limit. (auth)

25186 KINETIC THEORY OF ELECTROMAGNETIC WAVES OBLIQUELY INCIDENT UPON A PLASMA SLAB. Swift, Calvin T.; Crownfield, Frederic R. Jr. (Coll. of William and Mary, Williamsburgh, Va.). IEEE (Inst. Elec. Electron. Eng.), Trans. Antennas Propagation; AP-19: 81-90(Jan 1971).

The problem of an electromagnetic wave obliquely incident upon a plasma slab is considered as a boundary-value problem, using a self-consistent solution of the coupled linearized Vlasov and Maxwell equations for the electrons, with the ions treated as a fixed, uniform background. Power reflection, transmission, and absorption coefficients are derived under the assumption that electrons undergo specular reflection at the surfaces of the plasma slab. Although the analysis is valid for arbitrary slab thickness, computational results are presented for slabs that are thin compared to a free-space wavelength. The results show a series of resonances that are attributed to the kinetic behavior of the plasma. The results further show that the resonances are Landau damped as the thermal velocity of the plasma electrons increases. While similar resonances can be predicted from the coupled linearized hydrodynamic Maxwell equations, such a model does not predict Landau damping. The effects of a finite collision frequency are then included via a simple Bhatnagar–Gross–Krook collision term. The numerical computations vividly indicate that the resonances undergo severe damping for extremely small ratios of the collision frequency to signal frequency. (auth)

25187 NONLINEAR REFLECTION AND TRANSMISSION OF ELECTROMAGNETIC WAVES BY MOVING PLASMAS. Chakravarti, A. K. (Indian Inst. of Tech., New Delhi). IEEE (Inst. Elec. Electron. Eng.), Trans. Antennas Propagation; AP-19: 145-7(Jan 1971).

Based on the covariance principle of Maxwell's equations and phase-invariance principle (derived from the special theory of relativity), expressions for the nonlinear reflection and transmission of electromagnetic waves from weakly ionized plasmas moving perpendicular to the interface were obtained. It is seen that the effect of nonlinearity is quite appreciable, even when the electromagnetic waves are moderately strong. (auth)

25188 ION WAVES IN A WEAKLY IONIZED PLASMA. Tanibayashi, Mamoru (Nagoya Univ., Japan). J. Phys. Soc. Jap.; 30: 1188-93(Apr 1971).

The character of the propagation of ion waves in a weakly ionized plasma is studied experimentally. Ion waves are found to be waves of diffusion-type when the exciting frequency is lower than the collision frequency between ions and neutral atoms, and otherwise, ion waves are acoustic waves. From the waves of diffusion-type, diffusion coefficients are obtained that are nearly equal to the values obtained by others. (auth)

25189 NONLINEAR INTERACTION OF BERNSTEIN WAVES IN A BEAM–PLASMA SYSTEM. Idehara, Toshitaka; Ohkubo, Kunizo; Tanaka, Shigetoshi (Univ. of Kyoto). J. Phys. Soc. Jap.; 30: 1169-77(Apr 1971).

Bernstein waves (electron cyclotron harmonic waves) are observed to excite and grow exponentially in distance up to saturation levels and then damp slowly when a gyrating electron beam is injected into a plasma in thermal equilibrium. As the beam becomes intense, the harmonics of the Bernstein waves ascribed to a nonlinear interaction appear. In accordance with an increase of the emission power of harmonics, widths of these harmonics become broad and then their spectra become continuous, showing that they resemble closely the turbulence spectra. The experimentally observed characteristics of the Bernstein waves are very similar to those of Landau waves and have close correlations with the beam–plasma discharge. (auth)

25190 WAVE GENERATION IN A PLASMA WITH A DENSITY GRADIENT. Boulanger, P. (Univ. of Colorado, Boulder). J. Phys. (Paris); 31: 993-8(Nov-Dec 1970). (In French).

Generation of transverse electromagnetic waves by a longitudinal acoustic wave impinging on a density gradient in a plasma and the reciprocal process of generating longitudinal waves from an electromagnetic wave are examined. The case considered is when the length of the electron-density variation is small in comparison with the vibration considered. The coupling between the waves on both sides of the density gradient is calculated using the boundary conditions imposed on the electric and magnetic fields and the kinetic pressure of the wave. (auth) (France)

25191 TRANSFORMATION OF SURFACE WAVES INTO LONGITUDINAL OSCILLATIONS IN THE REGION OF STRONG INHOMOGENEITY OF COLD MAGNETOACTIVE PLASMA. Dolgopolov, V. V.; Omel'chenko, A. Ya. (Inst. of Physics and Tech., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 15: 1897-1907 (Nov 1970). (In Russian).

Electromagnetic oscillations due to an initial perturbation at the boundary of a semi-infinite magnetoactive plasma and vacuum are investigated taking into account finiteness of the transition zone between a homogeneous plasma and vacuum and also in an inhomogeneous plane-parallel magnetoactive plasma layer in the case when the length of the wave propagating along the layer is much greater than its width. It is shown that for the period determined by the width of the inhomogeneous region, the surface waves produced by the initial perturbation completely change into longitudinal oscillations along the direction of the plasma density gradient, the oscillations being concentrated in the vicinity of the point of plasma resonance for the surface-wave frequency. Thus, it is impossible to consider the surface waves at the boundary of semi-infinite plasma and vacuum with account for the finiteness of the transient region between plasma and vacuum and also the waves propagating along the inhomogeneous narrow plane-parallel layer of the plasma as free oscillations. These waves present a transient state from the initial perturbation to longitudinal oscillations in the direction of the medium density gradient. (auth)

25192 PHASE LOCKING OF COUPLED MODES IN NONLINEARLY UNSTABLE PLASMAS. Wilhelmsson, H.; Oestberg, K. (Univ. of Uppsala). Phys. Scr.; 1: 267-8(1970).

Phase-locking of three coupled modes for plasma systems that are explosively unstable is discussed. The study is carried out within the framework of the well-defined phase description. It turns out that appreciable phase locking occurs in a period of time shorter than the time the explosive instability needs to develop. (auth) (Sweden)

25193 NONLINEAR DAMPING OF LONGITUDINAL ION MODES. Pocobelli, Gustavo (Univ. of Saskatchewan, Saskatoon). Can. J. Phys.; 49: 412-19(15 Feb 1971).

The nonlinear damping rate of an ion mode in an infinite, homogeneous plasma is calculated for $T_e \gg T_i$ by means of the Vlasov–Poisson system (T_e and T_i indicate the electron and ion temperature, respectively). It is found that after the well-known linear

stage [$t/\tau_c \ll 1$, $\tau_e \equiv (m/eAk)^{1/2}$; A ≡ amplitude of the mode at t = 0], a nonlinear-electron linear-ion stage sets in [$\tau_e \lesssim t \ll \tau_i$, $\tau_i \equiv (M/eAk)^{1/2}$], during which the electron contribution to the damping rate diminishes substantially. The ions still give a linear contribution. Eventually, in the nonlinear ion stage ($t/\tau_i \gg 1$) the damping rate of the mode phase mixes to zero. (auth) (Canada)

25194 LOW-FREQUENCY ECHO OSCILLATIONS IN NONEQUILIBRIUM PLASMA. Pavlenko, V. N. (Inst. of Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 15: 1886-92(Nov 1970). (In Russian).

A consideration is made of the effects of time and spatial echo in nonisothermal nonequilibrium plasma penetrated by a compensated beam of low-density charged particles. It is shown that, with the excitation of two intensely damped short-wave oscillations, the long-wave echo oscillations can appear at the frequency of nonisothermal sound. The growths of the appearing low-frequency oscillations are investigated in time in the case of time echo and in amplification in space in the case of spatial echo. (auth)

Shielding

Refer also to abstracts 24875, 25552, and 25617.

25195 (JINR-P1-5676) APPROXIMATE EXPRESSION FOR IONIZATION LOSS AND RANGE OF FAST PARTICLES. Vzorov, I. K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1971. 9p. (In Russian). Dep. NTIS (U. S. Sales Only).

It is shown that the Bethe–Bloch formula for ionization loss by fast charged particles can be reduced to an approximate expression and that an analytical form can be obtained for the range–energy relation. In this case the accuracy of calculation will be not more than ±5% for the ionization loss and ±2 to 4% for the range. (auth)

25196 (KFKI-70-37-RPT) CALCULATION OF MULTIGROUP SPECTRA OF NEUTRONS TRANSMITTED THROUGH MULTILAYER SHIELDING. Vertes, Peter (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). [1969]. 8p. Dep. NTIS (U. S. Sales Only).

Albedo operator formalism is used for computation of 26-group neutron transmission. The resulting code, MUSPALB, can calculate not only the transmitted and reflected neutron spectra of a multilayered slab but also the spectra inside the shielding. The code is written in FORTRAN-IV for the ICL-1905 computer. (auth)

25197 (ORNL-tr-2424) GAMMA-RAY SHIELDING BY HIGH-DENSITY CONCRETES WITH DENSITIES FROM 3.2 UP TO 3.8 g/cm^3. Krueger, F. W. Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from Kernenergie; 13: 172-8(1970). 11p. Dep. NTIS.

An abstract of this paper, prepared from the original language, appeared as NSA 25: 3172.

25198 (ORNL-tr-2437) DESIGN OF RADIATION SHIELDS AGAINST GAMMA-RADIATION FROM SPENT NUCLEAR FUELS. Krueger, F. W. Translated by R. Gregg Mansfield (Oak Ridge National Lab., Tenn.), from Kernenergie; 13: 287-90(1970). 5p. Dep. NTIS.

An abstract of this paper, prepared from the original language, appeared as NSA 25: 11948.

25199 SCATTERING AND ENERGY LOSS OF 5- TO 30-keV ELECTRONS IN THIN FILMS. Inada, T.; Hoshino, K.; Matsuzawa, H. (National Inst. of Radiological Sciences, Chiba, Japan). Phys. Med. Biol.; 16: 25-34(Jan 1971).

The transmitted angular distributions and energy loss of an initially monoenergetic electron beam were measured for thin aluminium and polystyrene films, over the scattering-angle range $0° \leq \theta \leq 70°$, with films thinner than 50 $\mu g/cm^2$, and for incident electron energies of 5, 10, 15, and 30 keV. The measured angular distribution of scattered electron fluence was found to be in fairly good agreement with Lenz's calculation. The mean scattering angle and the most probable scattering angle were related to the number of elastic scatterings in the film. It was found that the mean energy loss depended on the scattering angle, and the experimental values for mass stopping power agreed with theoretical ones only over a limited range of angles near the most probable angle. (auth) (UK)

25200 PRINCIPLE OF BOUNDARY SOURCES IN THE ALBEDO PROBLEM FOR A SEMI-INFINITE MEDIUM. Rumyantsev, G. Ya. This paper was summarized in At. Energ. (USSR); 26: 447(May 1969) as paper No. 287/5131. (In Russian).

The classical one-dimensional problem concerning the reflection of neutrons from a semi-infinite medium without an allowance for their moderation was solved. Simple, but sufficiently accurate, working equations for an arbitrary angular distribution of neutrons incident to the medium were obtained. (TSS)

25201 DETERMINATION OF dE/dx FOR 7- TO 17-MeV ALPHA PARTICLES FROM ENERGY LOSS MEASUREMENTS IN LANTHANUM MAGNESIUM NITRATE SINGLE CRYSTALS. Dannheim, H.; Gaissmaier, B.; Kroeniger, D.; (and others). (Univ., Erlangen, Ger.). Z. Phys.; 241: 130-7(1971).

dE/dx for 7- to 17-MeV alpha particles in lanthanum magnesium nitrate single crystals parallel to the crystal c-axis was determined experimentally. It was found that the Livingston–Bethe–Bloch theory essentially holds in this range of energies, but that values for dE/dx calculated simply by addition of the energy losses caused by the different constituent atoms of the compound are in error up to 20%. (auth)

25202 ATTENUATION OF 4 TO 32 MV X-RAYS IN ORDINARY CONCRETE, HEAVY CONCRETE, IRON, AND LEAD. Maruyama, Takashi (National Inst. of Radiological Sciences, Chiba, Japan); Kumamoto, Yoshikazu; Kato, Yoshio; Hashizume, Tadashi; Yamamoto, Moriyuki. Health Phys.; 20: 277-84(Mar 1971).

The broad-beam attenuation coefficients for lead, iron, heavy concrete and ordinary concrete were evaluated using the x ray beams from a 32 MeV betatron, a 31 MeV betatron and a 6 MeV linear accelerator for the purpose of the design of the protective shielding to be placed around high energy accelerators. Attenuations in these materials were determined by measuring the ionization in a cavity in a water phantom behind various thicknesses of materials. The variation in tenth-value thickness with field size for these materials is discussed on the basis of data obtained from the attenuation measurements. The tenth-value thickness for these materials is shown as a function of x ray energy. The tenth-value thicknesses determined using the three x ray generators are compared. (auth) (UK)

25203 ENERGY LOSSES EXPERIENCED BY ELECTRONS IN MATTER AND THE PHYSICAL DOSIMETRY OF ELECTRON BEAMS FROM SMALL ACCELERATORS (E < 3 MeV). Chabert, J. N. (CEA, Grenoble, France). Bull. Inform. Sci. Tech. (Paris); No. 152, 55-70(Oct 1970). (In French).

The phenomena associated with energy losses experienced by electrons in matter are reviewed. Curves are presented, which correspond to the energy losses suffered by 0.6- to 3-MeV electrons in Al and to the dose distributions within thick samples. Methods suitable for the dosimetry of an electron beam are described. (auth) (France)

25204 EXPERIMENTAL EVALUATION OF A SIMPLE FORMULA FOR THE RANGES OF HEAVY IONS IN COMPOUNDS. Denschlag, Hans Otto; Weber, Max (Univ., Mainz). Radiochim. Acta; 15: 9-13(Jan 1971). (In German).

The recoil range of fission products was measured in electrodeposited uranium oxide ($UO_2 \cdot 1.8\ H_2O$) in order to decide whether the rule that the stopping powers of the components in a chemical compound add up linearily applies to heavy ions or whether other assumptions are preferable. Sandwiches of aluminum foil and a thin uranium oxide layer electrodeposited onto another aluminum foil were irradiated in a reactor, and the recoil yield of 9 fission products in the mass range from A = 85 to 99 and A = 132 to 143 were determined radiochemically and/or by γ-spectroscopic measurement of the unseparated samples. The recoil ranges of the products were calculated from the measured recoil yields and thickness of the uranium oxide layers. It was found that the assumption of additivity of stopping powers and the Bragg–Kleeman rule allow a calculation of optimum thicknesses for sources of fission recoil products and for heavy-ion targets. (auth)

Solid-State Physics

Refer also to abstracts 23758 and 24856.

Radiation Effects

Refer also to abstracts 23594, 23762, 23933, 24604, and 24605.

25205 (N-71-10926) X-RAY AND ELECTRON DAMAGE OF CADMIUM SULFIDE. Boeer, K. W. (Delaware Univ., Newark. Dept. of Physics). Nov 1970. Contract NAS1-8787. 23p. (NASA-CR-1700). NTIS.

XUM

Studies of x-ray damage were performed on class-1 (Gross–Novikov) and class-2 cadmium sulfide crystals. Changes in class-1 spectral dependence photocurrents (SDP) and thermally stimulated currents (TSC) in crystals irradiated by 200-keV x rays are compared to observations of 250-keV irradiated class-2 crystals. The observations were attributed to the fact that the surface is especially sensitive to either ambient or to near-surface-layer radiation damage. Therefore, the damage threshold might be considerably lower for class-1 crystals. Studies of damage in class-2 crystals irradiated at 250 keV showed a TSC peak attributable to sulfur vacancies. The lifetime of the electrons increased rather than decreased. Brief comments on results of others using electrons rather than x rays are included for comparative purposes. (auth) (STAR)

25206 ELECTRON SPIN RESONANCE (ESR) STUDIES OF Gd^{3+} IONS IN CaF_2. Bevolo, Albert Joseph. St. Louis; St. Louis Univ. (1970). 177p. University Microfilms Order No. 71-3249. Thesis.

Previous ESR studies have established four different Gd^{3+} ($^8S_{7/2}$) centers in CaF_2 depending on the type of charge compensation for the Gd^{3+} ion. They are (1) the cubic Gd^{3+} center with nonlocal charge compensation, (2) the tetragonal Gd^{3+} center charge-compensated by an interstitial F^- ion ($Gd^{3+}:F^-$), (3) two different trigonal centers, one compensated by an OH^- ion ($Gd^{3+}:OH^-$) and the other compensated by an O^{2-} ion ($Gd^{3+}:O^{2-}$). This investigation was made on samples of CaF_2 containing one or more of these Gd^{3+} ESR centers. A new doublet structure has been observed on the ESR lines arising from the $Gd^{3+}:OH^-$ center in CaF_2. All seven ESR fine-structure lines exhibit a doublet splitting of 4.0 ± 0.1 gauss when the external magnetic field H is parallel to the [111] axis. The observed characteristics of the doublet splitting were consistent with the assumption that a super-hyperfine interaction exists between the Gd^{3+} ion and the ^{19}F nucleus located between the Gd^{3+} ion and the charge-compensating OH^- ion. The ESR spectra arising from the four Gd^{3+} ESR centers in CaF_2 exhibited a wide range of responses to x irradiation. They can be ranked in the following order according to their relative stability against decay by x irradiation: $Gd^{3+}:O^{2-}$ > cubic Gd^{3+} > $Gd^{3+}:F^-$ > $Gd^{3+}:OH^-$. The stability of the uncompensated cubic Gd^{3+} center as compared to that of the $Gd^{3+}:OH^-$ and the $Gd^{3+}:F^-$ centers was unexpected. Intensive x irradiation of CaF_2 samples containing the $Gd^{3+}:F^-$ center produced a new set of ESR lines. The behavior of these new lines as a function of irradiation dosage suggested that they arose from a single paramagnetic center. As the irradiation dosage increased, the growth rate of these new lines paralleled the decay rate of the ESR lines associated with the $Gd^{3+}:F^-$ center, indicating that this new center was due to Gd^{3+} ions. From the angular variation of these new lines, it was determined that the crystal field potential has trigonal symmetry along the [111] crystal axis. The crystal field splitting associated with this new Gd^{3+} ESR center, characterized principally by $b_2^0 = (2900 \pm 5) \times 10^{-4}$ cm^{-1}, is believed to be the largest ever observed for Gd^{3+}. (Diss. Abstr. Int., B)

25207 IMPURITY DEPENDENCE IN THE THERMAL AND RADIATION ANNEALING OF THE 65°K STAGE IN IRRADIATED n-TYPE GERMANIUM. Meese, Jon Michael. Lafayette, Ind.; Purdue Univ. (1970). 163p. University Microfilms Order No. 71-2649. Thesis.

Hot carrier electrical measurements of the conductivity of lightly doped n-type germanium were made at 4.2°K in order to monitor the defect concentrations produced by 1.0-MeV electrons. Approximately 85 to 90% of the damage produced by irradiation at 7°K recovers in a thermal annealing stage centered at 65°K. One explanation can be based on the possibility that an interstitial is free to migrate in the lattice at very low temperatures. The high recovery on annealing then implies that the interstitial is trapped at a substitutional impurity or some other type of lattice defect, thereby preventing it from migrating to the surface of the crystal. In order to investigate this possibility, isochronal and isothermal annealing experiments were performed on pairs of samples doped with approximately equal amounts of different group-V impurities. The annealing rate of the 65°K stage was found to depend on the type of impurity doping, with arsenic-doped samples annealing at a lower temperature than antimony-doped samples. Radiation annealing at 7°K was also studied by irradiating pairs of samples, damaged previously at 1.0 MeV, with low-energy electrons, which produce little additional damage. This irradiation annealed the samples, with the arsenic-doped samples showing the fastest recovery. A model for the 65°K stage is proposed in which the annealing is initiated by the breakup of an interstitial–group-V-impurity complex. The interstitial is treated as a freely migrating particle whose fate is governed by its own charge state as well as the charge states of the vacancy and group-V impurity. It is shown that such a model is consistent with results of others. (TSS) (Diss. Abstr. Int., B)

25208 EFFECT OF IRRADIATION ON THE ELECTRIC CONDUCTIVITY OF URANIUM ALLOYS CONTAINING ZIRCONIUM AND NIOBIUM. Raetskii, V. M.; Zavgorodnii, A. Ya.; Gomozov, L. I. At. Energ. (USSR); 29: 379-80(Nov 1970). (In Russian).

Study of a uranium alloy containing 8 at. % Zr and 12 at. % Nb indicated that the equilibrium transition temperature of this alloy to the γ state (660°C) is higher than that of an alloy containing 20 at. % Mo. The test specimens were subjected to homogenizing annealing at 1100°C and were quenched in water from 800°C, resulting in a homogeneous tetragonal distorted γ^0 phase. They were then exposed in the SM-2 reactor to integral fluxes of $\Phi_1 = 3 \times 10^{19}$ thermal neutrons/cm^2 at 70°C and $\Phi_2 = 9 \times 10^{20}$ n/cm^2 at 200°C. After the irradiation, the electrical resistivity was determined potentiometrically in the temperature range from −196 to +100°C with an accuracy of ~2%. It was found that the mean temperature coefficient of the resistivity, which was negative for the original alloy, increased as a result of the irradiation. After exposure to Φ_2, it became positive, whereas the specific resistivity decreased at −196°C and increased at +100°C with the dose. Change of the temperature dependence of the resistivity as a result of the phase change of the unirradiated uranium alloy containing Zr + Nb was determined on specimens cooled from the homogenized state at 800°C by quenching in water, and on specimens annealed at 500°C. The mean temperature coefficient of the alloy increased as the cooling rate decreased. The results indicated that the alloys are decomposed by irradiation. Fission of the uranium thus not only aids homogenization but generates decomposition centers and accelerates the decomposition of unstable alloys. (TTT)

25209 RADIATION-STIMULATED DIFFUSION IN KCl. Gotlib, V. I.; Trofimov, V. N.; Shvarts, K. K. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 6, 121-2(1970). (In Russian).

A high mobility of chlorine ions in KCl under the action of electron irradiation was established. The diffusion coefficient was estimated. At doses up to 10,000 Mrad, acceleration of sodium-ion diffusion has not been established. (auth)

25210 F^+ AND F' CENTERS IN MAGNESIUM OXIDE. Kappers, Lawrence Allen. Columbia, Mo.; Univ. of Missouri (1970). 102p. University Microfilms Order No. 71-3344. Thesis.

Single crystals of magnesium oxide were additively colored and irradiated with neutrons. F^+ and F' centers, i.e., oxygen-ion vacancies containing one and two electrons respectively, were produced by these treatments. The optical absorption bands of these two centers were observed to be extremely similar; however, using a photoconversion process the bands were distinguished and were observed at 77°K to peak at 4.96 and 5.03 eV, respectively. In the conversion process, electrons are excited from F' centers and subsequently trapped at impurity sites. F' centers are thereby converted into F^+ centers. Heating was observed to reverse the conversion process. The oscillator strength for the F' center is estimated to be 0.70 ± .05. The luminescence bands for the F^+ and F' centers were observed at 3.1 and 2.4 eV, respectively. Thermoluminescence and ESR were used to identify Fe^{2+} as the major electron trap in these crystals. The temperature dependence of these two bands was measured and is discussed. (Diss. Abstr. Int., B)

25211 TRAPPING OF RARE GASES IN NIOBIUM SINGLE CRYSTALS. Rantanen, R. O.; Donaldson, E. E. (Washington State Univ., Pullman). J. Vac. Sci. Technol.; 8: 23-6(Jan-Feb 1971).

From 17th National Meeting of the American Vacuum Society, Washington, D. C. See CONF-701011.

The (100) and the (111) faces of niobium single crystals were bombarded with noble-gas ions having kinetic energies between 100 and 1500 eV. Thermal release spectra were produced [E. V. Kornelsen, Can. J. Phys., 42: 364(1964)], and characteristic activation energies were inferred as described previously [R. O. Rantanen, A. L. Moen, and E. E. Donaldson, J. Vac. Sci. Technol., 7: 18(1970)]. These energies were compared with energies for thermally activated processes identified in niobium. Because the trapping probability for ions is greater in cold-worked metal than in an annealed metal, an investigation was made of samples annealed and mechanically stressed in vacuum. (auth)

25212 INFLUENCE OF ELECTRON IRRADIATION ON THE DRIFT VELOCITY OF LITHIUM IONS IN p-TYPE GERMANIUM. Vishnevskii, I. N.; Davydov, A. V. Sov. Phys.-Solid State (Engl. Transl.); 12: 1984-5(Feb 1971).

XUM

Translated from Fiz. Tverd. Tela; 12: 2475-6(Aug 1970).

Samples of Li-diffused Ge were irradiated with 4-MeV electrons on both sides; total dose received by each side was ~10^{17} electrons. Lithium drift was carried out in chloroform under two different sets of conditions, and the depth of drift was measured by Cu precipitation. The results show that irradiation slows down the drift of Li ions by a factor of ~0.6, presumably owing to radiation defects. (D.L.C.)

25213 SURFACE EFFECTS ON THE DIFFUSION RELEASE RATE OF RARE GASES. Elleman, T. S.; Ong, A. Sy (North Carolina State Univ., Raleigh). Contract AT(40-1)-3508. Phys. Status Solidi (a); 3: 921-7(16 Dec 1970).

The diffusion of gases injected into the surface layers of crystalline solids by an accelerator or fission recoil may be strongly influenced by surface properties of the solid. The diffusion of fission-recoiled ^{133}Xe in CsI and CaF_2 single crystals was studied for different surface conditions. Surface strain caused by mechanically polishing CsI produced varying diffusion coefficients consistent with gas atom trapping while the unstrained, chemically polished crystals exhibited classical diffusion. The surface evaporation of CaF_2 at high temperature increased the release rate of ^{133}Xe significantly above the diffusion release rate and different evaporation characteristics were observed for different crystal orientations. Thin surface films, formed on CaF_2 surfaces during heating in quartz or mullite tubes, retarded the gas release and produced release curves that could falsely be interpreted in terms of gas trapping within the crystal lattice. The results illustrate that considerable care must be exercised in recoil injection experiments to avoid anomalous surface effects. (auth)

25214 MECHANISM OF DISLOCATION PINNING IN γ-IRRADIATED NaCl CRYSTALS. Soifer, Ya. M. (Inst. of Solid State Physics, Chernogolovka, USSR). Phys. Status Solidi (a); 4: 333-8(16 Feb 1971).

Using the method of internal friction, the interaction between dislocations and pinning points produced by γ irradiation from a ^{60}Co source in NaCl single crystals was investigated. The effect of the irradiation dose on the amplitude-dependent internal friction in NaCl with dislocations introduced before and after irradiation was studied. It is shown that at small irradiation doses, the formation of pinning centers occurs most easily on dislocations and that the pinning is not connected with the electronic part of the color center. It is concluded that controlled introduction of pinning points on dislocations is possible in NaCl single crystals at low irradiation doses. (auth)

25215 METHOD FOR THE DETERMINATION OF THE ACTIVATION ENERGY OF RECOVERY PROCESSES AS APPLIED TO ELECTRON-IRRADIATED MOLYBDENUM. Afman, H. B. (Univ., Amsterdam). Phys. Status Solidi (a); 4: 427-33(16 Feb 1971).

A method to obtain accurate data on recovery processes is presented and subsequently applied to molybdenum that has been irradiated with electrons at liquid helium temperature. It is proposed that the recovery below 33°K is due to a stage I_A-I_E recovery mechanism. A peak centered at 40°K is analyzed, but no interpretation is presented. (auth)

25216 CHANNELING EFFECTS IN BLOCKING PHENOMENA. Fujimoto, F. (Tokyo Univ.); Komaki, K.; Maruyama, M.; Tsukada, K.; (and others). Phys. Status Solidi (a); 4: 485-90(16 Feb 1971).

The behavior of the channeling peaks and blocking dips observed in the two-dimensional spectrum (energy and scattering angle) of the (111) planar blocking of protons transmitted through thin crystals of germanium and silicon is studied. The experimental results are compared with the calculations. The discrepancies between experiment and calculation are explained by random scattering, which smears out the blocking profile within the angular region estimated from the multiple Coulomb scattering. (auth)

25217 POINT DEFECT ANNEALING IN UNIAXIAL PERMALLOY THIN FILMS IRRADIATED WITH 2-MeV ELECTRONS. Roth, M.; Cornier, G. (Centre d'Etudes Nucleaires, Grenoble, France). Phys. Status Solidi (a); 4: 519-29(16 Feb 1971).

Polycrystalline Ni82-Fe18 films on amorphous quartz substrates were irradiated with 2-MeV electrons between room temperature and 300°C. The annealing of the defects thus created was studied by the variations of the induced anisotropy (i.e., the directional atom pair ordering) produced by this annealing. The experimental results show that the main disappearing process of the point defects is their absorption in the grain boundaries and surfaces, in contrast to the bulk material where the defect clustering seems to be the determining phenomenon. However, divacancy formation, vacancy-interstitial recombination, and small clustering must also be taken into account in thin films below 250°C. (auth)

25218 DECHANNELING BY A STACKING FAULT. Mory, Jean (CEA, Fontenay-aux-Roses, France). J. Phys. (Paris); 32: 41-5(Jan 1971). (In French).

The effect of a stacking fault on the planar channeling of charged particles is described. A particle reaching the stacking fault experiences a sudden variation in its transverse energy, and is dechanneled if this energy is greater than a certain value. The probability of finding the channeling particle between two ordinates when this condition is fulfilled is determined. This probability depends upon the minimum particle-atom approach distance, which can be measured by a dechanneling experiment. A complete calculation is carried out for channeling α particles propagated along $\{111\}$ planes in gold containing intrinsic stacking faults. The calculated dechanneling coefficients Γ for different minimum approach distances d_a are: $d_a = a_{T.F.} = 0.105$ Å: $\Gamma = 0.17$; $d_a = 0.125$ Å: $\Gamma = 0.19$; $d_a = 0.155$ Å: $\Gamma = 0.24$. The results are in good agreement with an experiment that gave $\Gamma = 0.24$ for α particles channeling in the $\langle 112 \rangle$ direction in the $\{111\}$ planes of gold. (auth) (France)

25219 ACOUSTIC PARAMAGNETIC RESONANCE OF X-IRRADIATED RUBY. Anderson, R. S.; Brabin-Smith, R. G.; Rampton, V. W. (Univ. of Nottingham, Eng.). J. Phys., C (London); 3: 2379-86(Dec 1970).

The results of an acoustic paramagnetic resonance study of x-irradiated ruby using longitudinal ultrasonic waves at 9.1 to 9.6 GHz are presented. Most resonances are attributed to the Cr^{3+} ion, which is very strongly coupled to the lattice and is subject to a dynamic Jahn-Teller effect. Four principal resonances were observed with the magnetic field along the c axis at approximately 6.3, 7.7, 11.4, and 15.8 kG. These split up into several components as the field was turned away from the c axis. The results are in broad agreement with the theory of Bates and Dixon (J. Phys., C; 1: 859-71(1968) and 2: 2209-24(1969)). Lines due to other centres were observed. (auth) (UK)

25220 DEPENDENCE OF THE RESISTIVITY OF SEMICONDUCTING DIAMOND ON RADIATION DAMAGE AND ANNEALING. Horszowski, S. M. (Diamond Research Lab., Johannesburg); Lourens, J. A. J. J. Phys., C (London); 3: 2442-7(Dec 1970).

A semiconducting diamond was irradiated at ambient temperature with 1-MeV electrons. The dependence of the resistivity on the dose was consistent with annealing of the radiation damage during the course of the irradiation. The resistivity was then measured as a function of isochronal annealing in the range 200 to 1400°C. The results suggest the presence of a number of annealing mechanisms. At 1400°C the recovery was complete. The same specimen was then irradiated with 1-MeV electrons at 77°K. The variation of the resistivity with the dose was consistent with diamond being a partially compensated p-type semiconductor. The resistivity as a function of isochronal annealing in the range 100 to 1450°C again indicated the presence of a number of distinct processes. Reverse annealing was observed. The recovery was complete at 1450°C. (auth) (UK)

25221 NO-PHONON LINESHAPES AND CRYSTAL STRAIN FIELDS IN DIAMONDS. Davies, G. (King's Coll., London). J. Phys., C (London); 3: 2474-86(Dec 1970).

Many no-phonon lines in diamond are found to have the spectral intensity distribution $I(\nu) = a[b + (\nu - \nu_0)^2]^{-2}$ in the limit of low temperature. This distribution lies midway between the Lorentzian and Gaussian shapes and is close to a Voight function with Lorentzian and Gaussian components $L/G \simeq 0.5$. Detailed measurements on the width, energy, and shape of the 503-nm line produced by electron irradiation and annealing of a series of type I diamonds showed that the width and exact energy are partly dependent on the concentration of impurity nitrogen. This, and other evidence, suggests the nitrogen is predominantly in the form of small aggregates, rather than platelets. With this assumption, the width, exact energy, and lineshape may be closely related to the strain field produced by the nitrogen, using the theory developed by Stoneham (Proc. Phys. Soc. 89: 909-21(1966) and Rev. Mod. Phys., 41: 82-108(1969)) with the magnitude of the strain field derived from the lattice constant (Kaiser and Bond). The weak strain field of the nitrogen is shown to emphasize the effects of the minimum defect separation, resulting in this contribution to the width having the line shape $I(\nu)$. (auth) (UK)

25222 COLOUR CENTRES IN ELECTRON-IRRADIATED MgO. Chen, Y. (Oak Ridge National Lab., Tenn.); Trueblood, D. L.; Schow, O. E.; Tohver, H. T. J. Phys., C (London); 3: 2501-8(Dec 1970).

XUM

Oxygen ion vacancies which absorb light at 250 nm, were observed in "pure" MgO after irradiation with 0.23- to 29-MeV electrons. The threshold energy for anion vacancy formation was observed to occur at 0.33 MeV; this corresponds to a displacement energy T_d = 60 eV. Energy-independent damage was observed below the threshold energy. Zero-phonon lines were observed at wavelengths of 361.5, 1044.5, and 1342.5 nm in crystals irradiated at electron energies greater than 1.6 MeV. Optical bleaching experiments suggested that these lines were associated with trapped electron centres. The energy dependence of the growth rate of the 1044.5-nm line confirmed that intrinsic defect aggregates were involved, anion divacancies being the most probable. The zero-phonon line at 1342.5 nm had not previously been observed in MgO; it appeared to be associated with higher-order defect aggregates. (auth) (UK)

25223 EQUILIBRIUM TOPOGRAPHY OF SPUTTERED AMORPHOUS SOLIDS. II. Carter, G.; Colligon, J. S.; Nobes, M. J. (Univ. of Salford, Eng.). J. Mater. Sci.; 6: 115-17(Feb 1971).

The sputtering of an amorphous solid is considered analytically, and the equations of motion of the changing surface topography are derived. These equations are solved to show that a steady state is reached only in conditions where the surface topography consists of planes aligned, either parallel or perpendicular, to the direction of sputtering ion incidence. (auth) (UK)

25224 THERMOLUMINESCENCE PROPERTIES OF THE OPTICAL GRADE (LiF). Lee, Ge Chul; Lee, Sang Soo (Atomic Energy Research Inst., Seoul). J. Nucl. Sci. (Seoul); 10: No. 2, Part 1, 1-6(1970). (In Korean).

A comparison is made between the glow curves of optical-grade single crystals irradiated by ^{60}Co γ rays and of LiF activated by impurities. Because the LiF used in this experiment is not activated by impurities, the level of thermoluminescence is low and shapes of the glow curves are different. Thus, the effects of the activated impurities can be easily seen. In addition, the annealing effect of the experimental materials is examined, but the dependency of this effect in annealing time and temperature does not exceed more than ±5%. The influence of the rate of temperature increase of the electric furnace is discussed, and the experimental apparatus is described. (auth)

25225 COLOR CENTERS IN MgO:Ni INDUCED BY NEUTRON IRRADIATION. Okada, Moritami; Nakagawa, Masuo; Atobe, Kozo; Shibata, Toshikazu (Kyoto Univ.). J. Phys. Soc. Jap.: 30: 1096-1100(Apr 1971).

New absorption bands at 365 and 460 nm are introduced in Ni-doped MgO single crystals irradiated by reactor neutrons. The 365- and 460-nm band intensities increase proportionally with neutron dose and connected intimately with the quantity of doped Ni ions. It is suggested to assign the 365- and 460-nm bands to the Ni ion center associated with a vacancy or an irradiation defect in the MgO crystal. (auth)

25226 THERMOLUMINESCENCE OF NaCl:Tl AT 340°K. Joshi, R. V.; Joshi, T. R. (Maharaja Sayajirao Univ., Baroda, India). J. Lumin.; 3: 389-94(Mar 1971).

Thermoluminescence and optical absorption were studied in x-irradiated NaCl : Tl crystals. It is suggested that the filled electron traps and the filled hole traps responsible for the 340°K glow peak are the F-centers and the Tl^{2+} ions, respectively. The emission at 340°K results from the thermal release of F electrons and their recombination with the holes at Tl^{2+} centers. (auth)

Physical Properties

Refer also to abstracts 24573, 24574, 24576, 24666, 24844, 25036, and 25768.

25227 (INIS-mf-18) DEFECT STRUCTURE AND IONIC CONDUCTIVITY OF ZIRCONIA AND THORIA. Subbarao, E. C.; Chaudhary, C. B.; Mehrotra, A. K.; Patil, R. N. (Department of Atomic Energy, Bombay (India). Chemistry and Metallurgy Committee). 1970. 7p. (CONF-700218-17). NTIS (U. S. Sales Only).

From Symposium on materials science research; Bangalore, India (24 Feb 1970).

A systematic study of the role of ionic size and charge on ionic conduction in the $ZrO_2-Y_2O_3-Nb_2O_5$ system was made. The effect of small defect concentration on the properties was studied in detail for the ThO_2-CaO system. X-ray diffraction results of sintered samples in the above systems are presented. (INIS)

25228 ELECTRICAL CONDUCTIVITY OF SINGLE-CRYSTAL CeO_2. Brugner, F. S.; Blumenthal, R. N. (Marquette Univ., Milwaukee). J. Amer. Ceram. Soc.; 54: 57(Jan 1971). (COO-1441-11).

The electric conductivity of monocrystalline CeO_2 was determined as a function of temperature and O_2 partial pressure at 800 to 1500°C and 1 to 10^{-14} atm of oxygen. (G.M.C.)

25229 LES PROPRIETES PHYSIQUES DES SOLIDES SOUS PRESSION. (Physical Properties of Solids Under Pressure). International Meeting, Grenoble, France, 8-10 September 1969. Paris; Centre National de la Recherche Scientifique (1970). 519p. (In French and English). (CONF-690908).

Sixty five papers were presented. The following topics were covered: perfect crystals, metals, semiconductors, imperfect crystals, magnetism, change in crystallographic phase, and new techniques. Individual abstracts were prepared for thirteen papers. (France)

For abstracts of individual papers see: 24568-24570, 24651, 25027-25029, 25230-25234, and 25267.

25230 REMARKS ON THE ELECTRONIC PROPERTIES OF METALS UNDER PRESSURE. Blandrin, Andre. (Paris Univ., Orsay, France). pp 87-93 of Les Proprietes Physiques des Solides Sous Pression. Paris; Centre National de la Recherche Scientifique (1970). (In French).

From International Conference on the Physical Properties of Solids Under Pressure, Grenoble, France. See CONF-690908.

Remarks are presented on the electronic properties of metals under pressure: band structure and crystallographic structure; influence of the band structure on the superconductive and magnetic properties; pressure effects on impurities; electronic transitions. (auth) (France)

25231 YTTERBIUM UNDER PRESSURE. Jerome, D. (Paris Univ., Orsay, France); Rieux, M.; Achard, J. C. pp 157-64 of Les Proprietes Physiques des Solides Sous Pression. Paris; Centre National de la Recherche Scientifique (1970).

From International Conference on the Physical Properties of Solids Under Pressure, Grenoble, France. See CONF-690908.

Hall effect and magnetoresistance measurements were made on Yb at 4.2°K under a hydrostatic pressure up to 14.7 kbar. Resistivity measurements were performed up to 16 kbar between 4.2 and 300°K. A two-band model was used to calculate the pressure dependence of carrier density and mobility from the data. The carrier density was found to disappear at 14 kbar with a change in the sign of the Hall constant at 4°K. A change in the temperature behavior of the resistivity with the occurrence of an activation energy was observed at P > 14 kbar. The experimental results support the picture of a transition from a metal to an insulator in Yb. (auth) (France)

25232 MAGNETO-ELASTIC INTERACTIONS IN Gd AND MnO. Bartholin, Henri; Bloch, Daniel; Georges, Roland. (CNRS, Grenoble, France). pp 301-9 of Les Proprietes Physiques des Solides Sous Pression. Paris; Centre National de la Recherche Scientifique (1970). (In French).

From International Conference on the Physical Properties of Solids Under Pressure, Grenoble, France. See CONF-690908.

The dependence of the exchange interactions on the interatomic distances and its principal consequences are discussed for MnO (an insulating, cubic, and antiferromagnetic material) and for Gd (a metallic, hexagonal, and ferromagnetic material). The results obtained using hydrostatic or uniaxial stresses are given. The change in the exchange interaction coefficients with the crystalline parameters is deduced. The results are used to explain spontaneous and forced anisotropic magnetostriction. (auth) (France)

25233 EFFECT OF AXIAL COMPRESSION ON THE NEEL POINT OF DYSPROSIUM. Landry, P. C. (McGill Univ., Montreal). pp 319-23 of Les Proprietes Physiques des Solides Sous Pression. Paris; Centre National de la Recherche Scientifique (1970).

From International Conference on the Physical Properties of Solids Under Pressure, Grenoble, France. See CONF-690908.

By using an induction technique and applying stress P_c parallel to the c axis of a single-crystal disc of dysprosium metal up to 450 bar, the shift in the Neel point T_N was found to be $dT_N/dP_c = -(0.81 \pm 0.05)$°K/kbar. From this it was shown that: $(\partial T_N/\partial \ln a) = (\partial T_N/\partial \ln b) = -22$°K and $(\partial T_N/\partial \ln c) = +55$°K. It was also shown that T_N is not a function of the c/a ratio. It was necessary to devise a new coil geometry because the c axis is magnetically very hard in dysprosium. This made it possible to employ adjustable high-permeability magnetic intensifiers in the cores of the coil. These increased the signal-to-noise ratio by a factor of 15. (auth) (France)

25234 MAGNETIC PERMEABILITY ANOMALY IN HEXAGONAL CLOSE-PACKED METALS. Milstein, Frederick (Rand Corp., Santa Monica, Calif. Univ. of California, Los Angeles); Robinson, Lawrence Baylor. pp 325-32 of Les Proprietes Physiques des Solides Sous Pression. Paris; Centre National de la Recherche Scientifique (1970).

From International Conference on the Physical Properties of Solids Under Pressure, Grenoble, France. See CONF-690908.

Inductance measurements with polycrystalline Gd exhibited an anomalous giant permeability well below the Curie temperature. This giant permeability was evidently related to the anomaly in the weak-field magnetization curves of polycrystalline Gd observed by K. P. Belov, who suggested that the anomaly implies a helical spin structure for Gd. However, such an anomaly was shown to occur for a hexagonal, ferromagnetic, polycrystalline material with low basal-plane anisotropy (such as Gd) when the direction of easy magnetization departs from the c axis. If the basal-plane anisotropy is neglected, the theoretical weak-field permeability is approximately proportional to $\sin\theta$, where θ is the angle between the c axis and the magnetization vector in a representative domain. Good agreement was obtained between the observed permeability and experimental values of $\sin\theta$ based upon magnetic anisotropy or neutron diffraction measurements of others. The effect of pressure was to lower the temperature at which the giant permeability occurs, at the rate $-2.6°K/kbar$. From this result, the change of the first magnetocrystalline anisotropy constant K_1 with pressure was calculated. Pressure also decreased the maximum amplitude of the permeability. This could be interpreted as a decrease in the angle θ with pressure. (auth) (France)

25235 ELECTRICAL AND OPTICAL PROPERTIES OF VO_2 NEAR THE SEMICONDUCTOR–SEMIMETAL TRANSITION POINT. Borisov, B. S.; Koretskaya, S. T.; Mokerov, V. G.; Rakov, A. V.; Solov'ev, S. G. Sov. Phys.-Solid State (Engl. Transl.); 12: 1763-9(Feb 1971).

Translated from Fiz. Tverd. Tela; 12: 2209-16(Aug 1970).

A study was made of the properties of single crystals and thin films of VO_2 above and below its semiconductor–semimetal phase transition temperature T_t. The temperature dependence of the electrical conductivity σ was determined. The reflection and transmission spectra were obtained in the $0.5\ eV \leq \hbar\omega \leq 6.2\ eV$ range and the effect of temperature on these spectra was studied. Possible causes of the nonlinear dependence of $\ln\sigma$ on $1/T$ were considered. Changes in the optical properties due to the transition included a shift, broadening, and partial overlap of the 3d energy bands. A model of the energy spectrum of the 3d electrons near the Fermi level was deduced. The optical properties of VO_2 in the energy range $\hbar\omega > 2\ eV$ were interpreted on the basis of the band structure of TiO_2. (auth)

25236 INFLUENCE OF TEMPERATURE AND MAGNETIC FIELD ON THE OPTICAL TRANSMISSION OF AN EuO SINGLE CRYSTAL. Skornyakov, G. P.; Samokhvalov, A. A.; Chukina, T. P. (Inst. of Metal Physics, Sverdlovsk, USSR). Sov. Phys.-Solid State (Engl. Transl.); 12: 1952-4(Feb 1971).

Translated from Fiz. Tverd. Tela; 12: 2442-4(Aug 1970).

A study was made of the optical transmission of an EuO single crystal in the temperature range 30 to 293°K in magnetic fields up to 2.7 kOe. The transmission was measured in the wavelength range $\lambda = 0.9$ to 2.7 μ. Magneto-optical measurements were carried out using the Voight geometry. Experiments showed that cooling below the Curie point (~70°K) caused a strong shift of the short-wavelength transmission edge toward lower energies and a simultaneous increase of the steepness of this edge. The temperature coefficient $\Delta E/\Delta T$ representing the edge shift had its maximum value of $+3 \times 10^{-3}$ eV/deg in the temperature range 60 to 70°K. The temperature dependences were in agreement with those obtained by Busch, Junod, and Wachter. The application of a magnetic field produced a considerable shift of the transmission edge in the direction of shorter wavelengths if the temperature of the sample was below the Curie point. This effect was attributed to the influence of ferromagnetic domain dimensions on the optical transmission. (auth)

25237 INVESTIGATION OF TANTALUM FILM PROPERTIES BY LAYERS. Livermore, F. C.; Wilcox, P. S.; Westwood, W. D. (Northern Electric Co., Ltd., Ottawa). J. Vac. Sci. Technol.; 8: 155-8(Jan-Feb 1971).

From 17th National Meeting of the American Vacuum Society, Washington, D. C. See CONF-701011.

A technique was developed, which has made it possible to determine the resistivity (ρ) and the temperature coefficient of resistance (TCR) of layers at different depths in thin tantalum films. The method involves a measurement of the sheet resistance and TCR before and after anodization steps and simultaneous measurements of the oxide growth kinetics. It is shown that there can be a significant variation in the film properties with depth. A 1000-Å thick film, reactively sputtered in an argon–oxygen atmosphere, appeared to have a resistivity of 1000 $\mu\Omega$-cm and a TCR of −120 ppM/°C but investigation by this technique showed that ρ actually varied from approximately 3000 $\mu\Omega$-cm at the air–film interface to 400 $\mu\Omega$-cm at the film–substrate interface, and the TCR varied from −1200 ppM/°C to approximately 0 ppM/°C. Oxide growth kinetics showed that the oxygen content of the film was approximately 50 at. % near the surface but only 30 at. % in the bulk of the film. (auth)

25238 DIELECTRIC RESPONSE AND INFRARED SPECTRUM OF STOICHIOMETRIC PLUTONIUM DIOXIDE BY OPTICAL REFLECTION AND ABSORPTION SPECTROSCOPY. Manes, L.; Barisich, A. (European Inst. for Transuranium Elements, Karlsruhe, Ger.). Phys. Status Solidi (a); 3: 971-81(16 Dec 1970).

Measurements of the ir optical properties of PuO_2 were performed by room-temperature reflectivity at normal incidence and absorption. Results of reflection, analyzed by Kramers–Kronig and classical dispersion analyses, are fitted into a dynamical theory of fluorite structures. A comparison is established with UO_2 and ThO_2. One of the peaks of the two-phonon spectrum is partially interpreted, and an estimation of the Raman principal frequency for PuO_2 is provided. The anomalous behavior of the specific heat of PuO_2 as a function of temperature is discussed. (auth)

25239 IONIC CONDUCTION IN THE THORIA–YTTRIA SYSTEM. Casselton, R. E. W. (International Research and Development Co., Ltd., Newcastle upon Tyne, Eng.). Phys. Status Solidi (a); 3: K255-8(16 Dec 1970).

The association of vacancies into complexes was studied in Y_2O_3–ThO_2 at 1000°C using ionic conductivity data. Association coefficients were computed as functions of anion vacancy concentration from 0.002 to 0.06; the enthalpy for vacancy motion was calculated to be 0.995 ± 0.008 eV and found to be independent of concentration. The concentration of free vacancies contributing to ionic conduction is an order of magnitude higher in Y_2O_3–ThO_2 than in Y_2O_3–ZrO_2. (D.L.C.)

25240 DIELECTRIC CONSTANT OF ZIRCONIA AND LIME ZIRCONIA. Sanesi, Manlio (Univ., Pavia, Italy); Cremante, Giorgio; Pizzini, Sergio; Wagner, Vittoriano. Z. Naturforsch.; 26a: 159-64(Jan 1971).

The dielectric constant of monoclinic zirconia and of lime–zirconia (up to a CaO content of 20% mole) has been measured at 25°C by the powder method. For pure ZrO_2 the constant is 13.5, while for lime–zirconia a nonlinear dependence on the CaO content has been observed in the measured range, with a maximum at about 14% mole CaO. The results are discussed, in the light of the authors' previous density data for the same systems, in terms of the width of the homogeneity range of the solid solutions. (auth)

25241 INFLUENCE OF A MAGNETIC TRANSITION ON THE FARADAY EFFECT IN EuO NEAR THE ABSORPTION BAND EDGE. Knyazev, Yu. V.; Noskov, M. M. (Inst. of Metal Physics, Sverdlovsk, USSR). Sov. Phys.-Solid State (Engl. Transl.): 12: 2235-6(Mar 1971).

Translated from Fiz. Tverd. Tela; 12: 2766-8(Sep 1970).

The Faraday rotation was measured in an EuO single-crystal plate in the absorption-band edge region 1.25 to 2.30 μ below and above the Curie point (76°K). A magnetic field of 800 Oe was used, and measurements were made in N_2 at 293, 78, and 68°K. The dispersion of the Faraday effect showed that the angle α was a linear function of the square of the frequency. The temperature dependence showed that α increased most rapidly in the region of 78 to 68°K due to the transition at the Curie point. (D.L.C.)

25242 ADSORPTION OF LANTHANUM ON INDIVIDUAL FACES OF TUNGSTEN SINGLE CRYSTALS. Palyukh, B. M.; Yakivchuk, A. I. (Lvov State Univ.). Sov. Phys.-Solid State (Engl. Transl.); 12: 2189-90(Mar 1971).

Translated from Fiz. Tverd. Tela; 12: 2720-3(Sep 1970).

A field emission microscope with a tilting needle was used to measure the work functions φ of the (011), (010), (111), and (112) faces of a W single-crystal needle, before and after deposition with La at 300°K. The plot of φ vs deposition time shows that φ passes through a minimum and then reaches a plateau; the minima and plateau values are different for each face. (D.L.C.)

25243 FERROMAGNETISM OF EuB_6. Fisk, Z. (Univ. of Chicago). Phys. Lett.; 34A: 261-2(22 Mar 1971).

An explanation for the ferromagnetism of semiconducting EuB_6 as contrasted with the antiferromagnetism of metallic GdB_6 is

suggested, based on the Bloembergen–Rowland exchange interaction. (auth)

25244 NEUTRON-PHYSICS INVESTIGATIONS ON MAGNETIC TRANSFORMATION POINTS. Rauch, H. (Oesterreichische Hochschule, Vienna). Acta Phys. Austr.; 29: 137-51 (1969). (In German).

The effect of critical magnetic fluctuations and of stationary ferromagnetic regions on the scattered, reflected, refracted, and diffracted neutron intensity and the effect on the polarization degree of the neutron are considered. Experimental results are reported for Ni, Dy, and Tb, obtained in the vicinity of the magnetic transformation point, where the magnetic short-range ordering shows a continuous transition. Ferromagnetic short-range-ordering regions can also be detected above the Curie point. The interaction of neutrons with the stationary magnetic regions just under the Curie point is treated as a diffraction phenomenon on the region as a whole. (tr-auth)

25245 THEORY OF THE $\alpha-\gamma$ PHASE TRANSITION IN METALLIC CERIUM. Ramirez, Ricardo; Falicov, L. M. (Univ. of California, Berkeley). Phys. Rev., B; 3: 2425-30(15 Apr 1971).

A simple model for the $\alpha-\gamma$ phase transition in Ce is presented. It is based on the change of occupation number of the f levels, which are assumed to be atomic-like in character, i.e., highly correlated and with a very narrow bandwidth. The change in occupation number is, as a function of temperature, caused by the short-range part of the electron–electron interaction. The theory allows for the existence of a critical point. With the assumption of a linear relationship between f-level occupation numbers and lattice constant, pressure–lattice-constant isotherms are calculated. Curves for the paramagnetic susceptibility as a function of pressure and temperature are also presented. (auth)

25246 ELECTRICAL CONDUCTION OF ZIRCONIUM OXIDE FILMS. Chan, W. S.; Loh, C. K. (London Univ.). Thin Solid Films; 6: 91-105(Aug 1970).

The electronic conduction processes in anodic zirconium oxide films were studied under dc and ac conditions over a wide range of temperature and frequency. Provided that the dielectric films were heat treated, results showed that under dc fields, a single modified form of the Poole–Frenkel mechanism dominated the electronic conduction; under ac fields, however, the conduction was attributed to electronic hopping between localized sites. Thermally stimulated current (TSC) measurements showed that on heat treatment the TSC spectrum was broadened. Several forms of resistance switching have been observed; of these the bistable form was dominant and has been studied in some detail. (auth)

25247 EFFECT OF DEPOSITION PARAMETERS ON THE STRUCTURE AND RESISTIVITY OF MOLYBDENUM FILMS. Bosnell, J. R.; Voisey, U. C. (Royal Radar Establishment, Great Malvern, Eng.). Thin Solid Films; 6: 107-11(Aug 1970).

It has been previously noted that the structure of refractory metal films is strongly dependent upon the substrate temperature, particularly during sputtering. However, the effect of the partial pressure of the sputtering gas was not reported. The effects of this gas pressure, as well as substrate temperature, on the structure and resistivity of Mo films are reported. It is found that the sputtering gas pressure plays a crucial role in determining film structure and hence resistivity. Comparison with films made by electron-beam evaporation is made. (auth)

25248 MAGNETIC HARDNESS OF THE INTERMETALLIC COMPOUND $SmCo_5$ AS A FUNCTION OF PARTICLE SIZE. McCurrie, R. A.; Carswell, G. P. (Univ. of Bradford, Eng.). Phil. Mag.; 23: 333-44(Feb 1971).

The dependence of the coercivity, H_c, remanence coercivity, H_R, and remanence, M_R, on particle size was investigated at various temperatures from 77 to 297°K. The results show that H_c and H_R increase as the particle size and temperature decrease. There is strong evidence for the existence of a critical particle size ~45 μm below which the coercivities H_c and H_R increase very rapidly. This is also supported by the observation that there is an abrupt increase in the remanence, M_R, at a particle size ~45 μm. The effect of applying a field of 164 kOe was also investigated. It was observed that the coercivities, H_c, are increased by various factors up to a maximum ~30%. An attempt was made to relate the behavior of the material to two critical particle diameters derived by Brown (1969). (auth) (UK)

25249 MOTION OF PARTIALLY PINNED BLOCH WALLS IN MAGNETIC THIN FILMS. Andra, W. (Deutsche Akademie der Wissenschaften zu Berlin, Jena, Ger.). Phys. Status Solidi (a); 4: 381-6(16 Feb 1971).

The behavior of a 180° Bloch wall, which is partially pinned either at the film surface or within the magnetically hard film of a soft–hard two layer film system is calculated. An external magnetic field causes first a bending of the nonpinned part of the wall and then an irreversible jump. The critical wall motion field is calculated and shown to be nearly the flux-weighted average of the intrinsic coercive fields of the hard and the soft film. In certain cases, two different critical fields and, therefore, hysteresis loops with two jumps are to be expected. (auth)

25250 EXPERIMENTAL AND THEORETICAL INVESTIGATIONS OF DYNAMICAL NEUTRON DIFFRACTION BY USING CRYSTALS WITH A LOW DISLOCATION DENSITY. Eichhorn, F. (Deutsche Akademie der Wissenschaften, Berlin); Kosmowski, M.; Schoepf, H.-G.; Schulze, G. E. R. Phys. Status Solidi (a); 4: 445-57(16 Feb 1971).

Dynamical wave fields of thermal neutrons are considerably more sensitive to lattice perturbations than the corresponding x-ray and electron wave fields. Using thermal neutrons, double-crystal rocking curves were measured on germanium single crystals. The dislocation density ρ of the crystals used was between 10^3 and 10^5 cm^{-2}, and etching exhibited a random-like distribution of etch pits. With increasing dislocation density, a broadening of the rocking curves was measured. Moreover, the shape of the rocking curves changed from a Lorentzian profile for the perfect crystal more and more to a Gaussian profile. The abundance distribution $f_{ex}(\zeta)$ of the components ζ of the lattice distortion influencing the diffraction was calculated as a Gaussian one from the measured rocking curves using a simple geometrical diffraction model. On the other hand, the assumption of randomly distributed dislocations permits calculation also of a Gaussian-like distribution $f_{th}(\zeta)$ for these components of the lattice distortion with a half-width proportional to ρ^m with $m_{th} = 0.56$. This is in good agreement with the observed value $m_{ex} = 0.57 \pm 0.06$. (auth)

25251 MAGNETIC PROPERTIES OF CeB_6, PrB_6, EuB_6, AND GdB_6. Hacker, H. Jr.; Shimada, Y.; Chung, K. S. (Duke Univ., Durham, N. C.). Phys. Status Solidi (a); 4: 459-65(16 Feb 1971).

The results of a study of the magnetic properties of the hexaborides of cerium, praseodymium, europium, and gadolinium at temperatures from 7 to 300°K are reported. The susceptibility of CeB_6 obeys a Curie–Weiss law, $\chi = C/(T-\theta)$, above 200°K with a moment of 2.51 μ_B and $\theta = -82$°K. PrB_6 obeys a Curie–Weiss law above 100°K with a moment of 3.64 μ_B and $\theta = -41$°K. The reciprocal susceptibility of PrB_6 shows a minimum at 8.3°K associated with an antiferromagnetic transition. Europium hexaboride is ferromagnetic at low temperatures with a Curie point of 8.8°K. The initial reciprocal susceptibility in the range from 9 to 14°K varies as $(T-T_C)^{1.20}$. Above 30°K the susceptibility of EuB_6 accurately obeys a Curie–Weiss law with $\theta = -0.5$°K and $\mu_{eff} = 7.90$ μ_B. Magnetization curves and isotherms of σ^2 vs. H/σ are given for EuB_6 for temperatures just above the Curie point. The susceptibility of GdB_6 obeys a Curie–Weiss law above 70°K with $\theta = -66.5$°K and $\mu_{eff} = 7.98$ μ_B. Further, an antiferromagnetic transition exists at (16.4 ± 0.2)°K. Finally, x-ray-diffraction data were obtained for the four compounds yielding lattice constants of 4.140, 4.131, 4.175, and 4.109 Å for CeB_6, PrB_6, EuB_6, and GdB_6, respectively. (auth)

25252 KONDO CONDUCTANCE OF Al ALLOYS AT U ≈ 0. Ignatev, O. M.; Tarenkov, V. Yu.; Volkova, L. P.; Gavrish, Y. G. (Physical-Technical Inst., Donets, USSR). Phys. Status Solidi (a); 4: K147-9(16 Feb 1971).

Thin films of Al alloys containing low amounts of W and Mo were prepared, and the current and voltage (U) dependences of the Kondo conductance were measured at 1.7°K. The total conductance can be considered as the sum of ohmic and Kondo conductances, with the Kondo conductance being logarithmically dependent on U at low U values and zero at high U values. The critical voltage U_c depends on the type of doping impurity. The results may be interpreted in terms of electron–impurity quasi-bound states. (D. L. C.)

25253 OPTICAL AND PHOTOEMISSION STUDIES OF VOLUME STATES AND SURFACE OSCILLATIONS IN METALS. Endriz, John Guiry. Stanford, Calif.; Stanford Univ. (1970). 250p. University Microfilms Order No. 71-2756.

Thesis.

Optical studies of volume states in the alkaline-earth metals barium (bcc) and strontium (fcc) and rare-earth metals europium (bcc) and ytterbium (fcc) prompted a careful evaluation and redesign of the uv reflectometer used in these studies. Calibration procedures on this reflectometer led, in turn, to the observation of strong optical coupling to surface-plasma oscillations in the nearly-free-electron metal, aluminum. These plasmon excitations were investigated further in photoemission studies. Reflec-

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tance measurements on the alkaline earth and rare earth metals were carried out in situ from 1.0 eV to 11.6 eV. Extreme care was taken in all aspects of the work so that a Kramers–Krönig analysis of the reflectance data yielded optical constants ϵ_1, ϵ_2, σ, and α, which were accurate to better than ±20%. This accuracy was verified in the agreement between the volume loss function peak positions found in this study (barium, 7.33 eV; strontium, 8.27 eV) and the values (7.1 eV and 8.1 eV, respectively) obtained in the high-energy electron loss experiments of Kunz. A comparison of the interband optical conductivities for the alkaline-earth and rare-earth metals failed to indicate strong structure in the rare-earth metals which could be unambiguously attributed to transitions from 4f electrons found in europium and ytterbium. Comparisons of sum-rule calculations in these four metals also failed to show any increased oscillator strength attributable to 4f transitions in europium and ytterbium. (TSS) (Diss. Abstr. Int., B)

25254 CRITICAL ATTENUATION OF SOUND AT MAGNETIC PHASE TRANSITIONS. Pollina, Richard James. New Brunswick, N. J.; Rutgers–The State Univ. (1970). 160p. University Microfilms Order No. 71-3092.

Thesis.

Experimental results on critical velocity and attenuation changes are presented and discussed for longitudinal and shear ultrasound. Critical velocity changes show uniform behavior for all substances, a frequency-independent and a weak temperature-dependent effect; the critical attenuation changes show a wide variety of behavior for different materials. A given substance can be characterized by the following physical parameters: spin structure (ferro- or antiferromagnet), magnetic anisotropy, and range of spin interaction. Ultrasonic attenuation measurements were made over the frequency range 10 to 230 MHz in the rare-earth metals Gd, Tb, Dy, Ho, in the insulators EuO, MnF_2, $RbMnF_3$, and in Cr, in order to determine the nature of the attenuation singularity at the magnetic transition temperature. Longitudinal waves couple through the volume magnetostrictive interaction, while shear waves couple to the linear magnetostriction. (TSS) (Diss. Abstr. Int., B)

25255 CRITICAL MAGNETIC BEHAVIOR OF EuO. Groll, Guenter (Technische Univ., Munich). Z. Phys.; 243: 60-78 (1971). (In German).

Mössbauer-effect and magnetization measurements were employed to study the static and especially the dynamic magnetic properties of the nearly Heisenberg ferromagnet EuO near its Curie temperature, $T_c = 69.2°K$. The critical exponent β of the spontaneous magnetization was determined to be $\beta = 0.34 \pm 0.02$. It was shown that critical slowing down of spin fluctuations takes place near T_c with spin relaxation times between 7×10^{-11} sec ($T = 1.01\ T_c$) and 1.5×10^{-11} sec ($T = 1.03\ T_c$). The experimental values of the relaxation time were found to be in satisfactory agreement with theoretically computed ones. Just below T_c the Mössbauer spectra exhibit relaxation effects, which are characteristic of the occurrence of critical superparamagnetism. Investigations of several samples indicated quantitatively that critical superparamagnetism has its origin in the nonideal composition of the real crystal. (auth)

25256 LATTICE CONDUCTIVITY, LORENZ NUMBERS, AND NERNST–ETTINGSHAUSEN EFFECT IN TUNGSTEN AT LIQUID-HELIUM TEMPERATURES. Long, Jerome R. (Virginia Polytechnic Inst., Blacksburg). Phys. Rev., B; 3: 2476-84(15 Apr 1971).

A further analysis of previously published measurements of the dc electrical and thermal transport coefficients of a tungsten crystal is presented. The coefficients were measured as functions of a strong magnetic field at several temperatures in the range of liquid ^4He. Problems in separating the lattice thermal conductivity from the electronic thermal conductivity by a simultaneous study of the magnetoresistivities are discussed. The limiting conductivity obtained from such a study of the tungsten data is found to be in reasonable agreement with calculations based on the assumption of strongly coupled phonons scattered by nearly free electrons. From the same data, the Lorenz number is deduced as a function of temperature and found to be in excellent agreement with an electron–electron scattering formula given by Ziman. The transverse (Hall and Righi–Leduc) conductivities are used to deduce a transverse Lorenz number which displays an unexpected temperature dependence that is not explained. An apparent phonon drag effect, very similar to that found by Long et al. in the transverse (Nernst–Ettingshausen) thermoelectric coefficient of antimony, is found in the tungsten data for the same coefficient and is quantitatively explained by a simple model. An electronic specific-heat coefficient is also deduced from the Nernst–Ettingshausen data, and is found to have a value intermediate to the results of augmented-plane-wave (APW) and relativistic augmented-plane-wave (RAPW) Fermi surface calculations. (auth)

25257 RESISTIVITY OF SCANDIUM SINGLE CRYSTALS. Spedding, F. H.; Cress, D.; Beaudry, B. J. (Ames Lab., Iowa). J. Less-Common Metals; 23: 263-70(Mar 1971).

The resistivity of scandium was measured along the a-, b-, and c-axes from 2 to 300°K. Results of measurements on a polycrystalline sample are compared with an average of the single crystal results. With the exception of a polycrystalline samples with high tantalum impurity, no anomalies are observed. At low temperatures, the temperature dependence of the intrinsic resistivity, ρ_i, varied as $T^{3.1}$ for the a-axis sample and $T^{4.0}$ for the c-axis sample. The resistivity of the a-axis sample was about 2.2 times as much as that of the c-axis sample. No resistivity anisotropy was present in the basal plane greater than 2.2%, the accuracy with which the absolute resistivity is known. Hardness measurements gave a DPH hardness ratio of about 3.5 for the (0001) plane vs the $(10\bar{1}0)$ plane. Disk-shaped inclusions were present in the samples as a second phase. (auth)

25258 A STUDY OF THE LATTICE SPACINGS, MAGNETIC SUSCEPTIBILITIES AND ^{151}Eu MOESSBAUER SPECTRA OF SOME PALLADIUM–EUROPIUM ALLOYS. Harris, I. R. (Univ. of Birmingham, Eng.); Longworth, G. J. Less-Common Metals; 23: 281-92(Mar 1971).

The lattice spacings, magnetic susceptibilities, and ^{151}Eu Moessbauer spectra of some palladium–europium alloys were examined. The solid solubility of europium in α-palladium was 10 at. % at about 600°C, and this was succeeded by an intermediate phase at about 14 to 16 at. % Eu, probably Pd_5Eu. The lattice spacings, magnetic susceptibilities, and Moessbauer isomer shifts indicated that the europium atoms were in the 3-valent ($^7F_0$) state in the solid solution alloys, the Pd_5Eu phase, and in Pd_3Eu. In the alloys corresponding to Pd_2Eu, PdEu, $PdEu_2$, and $PdEu_3$, the magnetic susceptibilities and Moessbauer isomer shifts indicated that the europium atoms were in the 2-valent ($^8S_{\frac{7}{2}}$) state. Pd_2Eu, PdEu, $PdEu_2$, and $PdEu_3$ were magnetically ordered at 4.2°K with hyperfine fields at the europium nucleus of 17 ± 10, 162 ± 5, 148 ± 10, and 244 ± 15 kOe, respectively. (auth)

Moessbauer Effects and NMR

25259 ELECTRON SPIN RESONANCE SPECTRA OF THE CHROMIUM(III) OXIDE–MOLYBDENUM(VI) OXIDE SYSTEM. Rockenbauer, A. (Central Research Inst. for Chemistry, Budapest); Gati, Gy. Acta Chim. Acad. Sci. Hung.; 66: 293-306 (1970).

The paramagnetic resonance spectrum of chromium–molybdenum mixed oxides was investigated at various chromium : molybdenum ratios for various starting materials and at various ignition temperatures. The spectra exhibited lines of two types. One of them was a structureless broad singlet attributed to the Cr^{3+} ions in $Cr_2(MoO_4)_3$; the other was a narrow signal with anisotropic g and hyperfine structure, presumed to arise from Cr^{5+} ions located in the MoO_3 lattice. These Cr^{5+} ions of restricted number are formed only in special centers where OH^- groups are also present. The Cr^{5+} ion is surrounded by oxygen arranged in square-pyramidal symmetry. The strongest chromium–oxygen bond is formed with the oxygen located at the vertex on the fourfold axis. The bonding pattern of the structure is analogous to that of $(CrOCl_4)^-$; however, the in-plane σ bond is stronger, and the charge-transfer excitation energies are larger. Spectra in the X-band exhibit, besides the lines of the ^{53}Cr isotope, also a superhyperfine structure arising from hydrogen. (auth)

25260 MOESSBAUER EFFECT DATA INDEX. Covering the 1969 Literature. Stevens, John G.; Stevens, Virginia E. (eds.). New York; Plenum Publishing Corporation (1970). 315p. $24.00.

This volume, whose format is similar to that of the 1958–1965 predecessor, indexes all articles that appeared in 1969 in publications listed in Access. The data (source and absorber, temperature, spectral parameters) are listed for each isotope, and the references are collected in a single master list and in topical lists for analysis, instrumentation, etc. An author index to the 1969 references and a partial reference list for 1970 are also included. (D.L.C.)

25261 N. M. R. AND MAGNETIC SUSCEPTIBILITIES OF THE Ce–Al INTERMETALLIC COMPOUNDS. Niculescu, V. (Univ., Cluj); Pop, I.; Rosenberg, N. Phys. Lett.; 34A: 265-6(22 Mar 1971).

The temperature dependence of the Knight shift, NMR line width,

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and magnetic susceptibilities of $CeAl_4$, $CeAl_3$, and $CeAl_2$ were measured. All the calculated exchange constants T_{sf} are negative and between 0.15 and 0.25 eV. (auth)

25262 POSSIBLE APPLICATIONS OF NUCLEAR RESONANCE SCATTERING OF ANNIHILATION GAMMA RAYS IN THE INVESTIGATION OF ELECTRON MOMENTUM DISTRIBUTIONS IN MATTER. Davydov, A. V.; Kartashov, G. R.; Vishnevskii, I. N. Sov. Phys.-Solid State (Engl. Transl.); 12: 2068-70(Mar 1971).

Translated from Fiz. Tverd. Tela; 12: 2574-7(Sep 1970).

In an earlier experimental investigation, the authors detected resonance scattering of annihilation gamma rays by ^{106}Pd nuclei, which have a level with an energy 511.7 ± 0.3 keV and a lifetime of 11.3 ± 0.6 nsec. The annihilation gamma rays in copper arose as the result of the annihilation of positons formed by the beta decay of ^{64}Cu. The cross section for this process is determined not only by the nuclear characteristics of the scatterer, but also by the profile of the incident radiation spectrum, which in turn, depends on the momentum distribution of the annihilated pairs. If it is assumed that thermalized positons are annihilated principally with electrons of a degenerate Fermi gas, the experimental results can be related to the parameters of the Fermi electron distribution, in particular, to the Fermi energy. It is shown that the value of the cross section for resonance scattering measured by the authors differs strongly from that calculated under the assumption of a simple spherical form of the Fermi surface for copper. Possible causes for this discrepancy are discussed and ways are indicated in which the proposed method may be further developed. (auth)

25263 INVESTIGATION OF THE Y-Ce-H SYSTEM BY THE SPIN-ECHO METHOD. Khodosov, E. F.; Khodos, I. I. (Donetsk Physical-Technical Inst., USSR). Sov. Phys.-Solid State (Engl. Transl.); 12: 2213-15(Mar 1971).

Translated from Fiz. Tverd. Tela; 12: 2745-7(Sep 1970).

Proton relaxation was investigated in $YH_{1.91}$, $YH_{1.93}$, and $Y_{1-x}Ce_xH_{2.00-1.89}$ over the range $0.10 \leq X \leq 0.65$. The temperature dependence of the spin–lattice relaxation times T_1 and T_2 shows that T_1 for $YH_{1.93}$ and $Y_{1.91}$ passes through a minimum at ~10 msec, while for YCeH it is relatively constant with temperature and depends on the Ce content, dropping down to 450 μsec for 65% CeH. This anomalous behavior is due to the effect of the Cef electrons, which probably polarizes the conduction electrons. (D.L.C.)

25264 ^{151}Eu MOESSBAUER SPECTROSCOPIC STUDIES OF AFTER EFFECTS OF THE ELECTRON-CAPTURE DECAY OF ^{151}Gd. Glentworth, P.; Nichols, A. L. (Univ. of Leeds, Eng.). J. Chem. Soc., D; No. 4, 206-7(24 Feb 1971).

Moessbauer spectroscopy was used to observe the production of an "anomalous" charge state, $^{151}Eu^{2+}$, following the electron capture decay of $^{151}Gd^{3+}$ incorporated in $Er_2(C_2O_4)_3 \cdot 10H_2O$. (auth) (UK)

25265 NUCLEAR QUADRUPOLE RESONANCE IN INDIUM AND INDIUM–TIN ALLOYS. Palmer, John Parker. Riverside, Calif.; Univ. of California (1970). 106p. University Microfilms Order No. 71-3892.

Thesis.

Nuclear quadrupole resonance (NQR) line shapes are reported for the four transitions of pure indium and for the first three transitions of dilute alloys of tin in indium. The as-recorded resonance is measured by the slow passage, c-w, technique using magnetic field modulation. Pure NQR line shapes are determined by analytically demodulating the measured data. First- and second-moment analysis of the NQR line shapes for pure indium yields the pseudo-exchange and pseudo-dipolar coupling coefficients $\tilde{A} = 2.40 \times 10^{-46}$ erg-cm^3 and $\tilde{B} = 1.55 \times 10^{-46}$ erg-cm^3, respectively. Gross anisotropy in the line shapes of the alloys is discussed. Qualitative features of the anisotropy are in agreement with Thatcher's analysis in the magnetic regime. (Diss. Abstr. Int., B)

25266 KNIGHT SHIFT IN CADMIUM: FIELD AND TEMPERATURE DEPENDENCE. Goodrich, R. G.; Khan, S. A.; Reynolds, J. M. (Louisiana State Univ., Baton Rouge). Phys. Rev., B; 3: 2379-84(15 Apr 1971).

Measurements were performed of the Knight shift in cadmium as a function of field between 1 and 20 kG at 1.2°K and as a function of temperature between 1.2 and 300°K at 9.4 kG. The field-dependent studies show an oscillatory behavior of the Knight shift at the de Haas–van Alphen frequency appropriate to the first band in the higher-field ranges. In the low-field region the average value of the Knight shift is found to exhibit a strong anisotropic field dependence. The temperature-dependent measurements show that the anisotropy in the Knight shift reverses sign between 1.2 and 300°K. Measurements of the amplitude of the de Haas–van Alphen signals were performed in the same field range and orientation as the oscillatory Knight-shift measurements. All of the measurements reported are accounted for by the detailed field and temperature dependence of the topology of the cadmium Fermi surface. (auth)

Theory

Refer also to abstract 25029.

25267 SELF-CONSISTENT FIELD CALCULATIONS OF BULK PROPERTIES OF SOLIDS. Liberman, David A. (Los Alamos Scientific Lab., N. Mex.). pp 35-41 of Les Proprietes Physiques des Solides Sous Pression. Paris; Centre National de la Recherche Scientifique (1970).

From International Conference on the Physical Properties of Solids Under Pressure, Grenoble, France. See CONF-690908.

Self-consistent-field calculations were done for three solids, lithium, beryllium, and aluminum, in order to compute lattice parameters at zero pressure, cohesive energies, and zero-temperature equations of state to pressures above 10 megabars. The calculations were quite straight-forward: a Green-function band-structure program was used to compute densities of state and these in turn were used to do a self-consistent field-calculation in a spherical Wigner–Seitz cell. The charge density obtained in the second part of the calculation was then used to calculate the potential function for another band-structure calculation and the procedure was iterated as many times as it was necessary. (auth) (France)

25268 INTERRELATION BETWEEN THE ELECTRONIC STRUCTURE OF TRANSITION METALS AND ALLOYS AND PHYSICAL PROPERTIES, DEFINED BY THE FORCES OF COHESION. Chapnik, I. M. (Pedagogical Inst., Leningrad). Phys. Status Solidi (a); 3: K285-7(16 Dec 1970).

The dependence of elastic constants E and G, compressibility χ, thermal expansion coefficient α, and melting point T_m on the number of bonding electrons per atom N_K and the number of electrons remaining in the atomic core N_M was investigated for nonmagnetic and magnetic transition metals and actinides. The data, taken from Gschneidner (Solid State Phys. 16(1964)), are plotted versus N and N_K. E, G, χ, α, and T_M depend on N_K, and magnetic moments lead to a decrease in E, G, and T_M and to an increase in χ and α, which is equivalent to a decrease in cohesive forces. (D.L.C.)

Theoretical Physics

Refer also to abstracts 23906, 25277, and 25507.

25269 RADIATION FROM ELECTRONS IN THE FIELD OF TWO ELECTROMAGNETIC WAVES. Zhukovskii, V. Ch.; Kherrmann, I. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 11: 671-8(Nov-Dec 1970). (In Russian).

Radiation from electrons moving in a field of two plane electromagnetic waves with variable frequencies ω_1 and ω_2, and propagating in the same direction, is investigated. General formulas are obtained for the probability of photon emission by the electron in the field of these waves that hold true for arbitrary intensities. The emission should contain the harmonics and the sum and difference frequencies. The sum and difference frequencies were studied in the nonrelativistic and ultrarelativistic approximations. (tr-auth)

25270 ESTIMATION OF PHYSICAL PARAMETERS WITH THE BAYES PRINCIPLE. EXAMPLES FROM THE NUCLEAR RADIATION MEASUREMENT TECHNIQUE. Weise, Lothar (Kernforschungsanlage, Juelich, Ger.). Atomkernenergie; 16: 233-6(1970). (In German).

A method for statistical estimation of physical parameters, which may be called a classical one because its first appearance was long before the introduction of the usual present methods e.g., the Maximum Likelihood Method or the Least-squares Fit, is described. The method is based upon the Bayes Principle and will be called Bayes Estimation. Important examples of its application occur in nuclear radiation measurement technique. (R.W.R.)

25271 INVARIABLE RELATIONS IN RIEMAN SPACE. Stoka, Marius I. Rend. Semin. Mat. Fis. Milano; 39: 151-70 (1969). (In Italian).

From Symposium in Honor of Giuseppe Occhialini on the 20th

Anniversary of His Return to Italy, Milan, Italy. See CONF-681083.

The invariant affine connections on diverse classes of riemannian spaces given from their groups of movements are determined. (auth)

25272 MEAN GREEN'S FUNCTION: A NONLINEAR APPROXIMATION. Rosenbaum, Shalom (Polytechnic Inst. of Brooklyn). Radio Sci.; 6: 379-86(Mar 1971).

The behavior of the coherent Green's function in a randomly fluctuating, unbounded, and statistically homogeneous medium is examined. The starting point of the analysis is a nonlinear approximation of the Dyson equation that has been pointed out by several investigators. Although exact solutions seem out of reach, owing to the inherent complexity of the problem, approximate solutions that are applicable in the limits of small and large-scale fluctuations can be obtained. The large-scale fluctuations are emphasized. Both one- and three-dimensional fluctuations are considered, and explicit calculations are made for the case in which an exponential correlation governs the refractive-index fluctuations. The solutions obtained are investigated in various limiting cases for which closed-form results are derived. (auth)

25273 ANALYSIS OF ENERGY DISTRIBUTION OF ELECTRONS MOVING ALONG CURVILINEAR TRAJECTORIES. Shustin, E. G.; Kharchenko, I. F. (Inst. of Radiotechniques and Electronics, Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 13: 1800-4(1970). (In Russian).

A method is proposed to analyze the two-dimensional electron distribution function applied to electron beams moving in longitudinal external magnetic fields. The comparison of the delay curves for the analyzer with the decelerating field placed in the uniform magnetic field and in the trap-type configuration field makes it possible to determine the mean energy of the transverse motion of electrons corresponding to any point of the electron distribution function over the longitudinal velocities. The analyzer design is described for studying the electron energy distribution in the beam–plasma system. The basic results of investigating the excitation of transverse beam oscillations in such a system are given. (tr-auth)

25274 INTERACTION OF THE SPIRALING ELECTRON BEAM WITH ELECTROMAGNETIC WAVES PROPAGATING OBLIQUELY TO THE MAGNETIC FIELD. Kotsarenko, N. Ya.; Koshevaya, S. V.; Fedorchenko, A. M. (Kiev State Univ.). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 13: 1805-9(1970). (In Russian).

The dispersion equation for the infinite relativistic beam of electrons moving along the spiral trajectories and interacting with fast electromagnetic waves traveling obliquely to the magnetic field is developed. (tr-auth)

25275 A STUDY OF DECAY IN QUANTUM MECHANICS. Soldi, Angelaurelio. Chapel Hill, N. C.; Univ. of North Carolina (1970). 74p. University Microfilms Order No. 71-3598. Thesis.

The decay of an unstable system was studied from two points of view: either as an initial-value problem or as a scattering problem characterized by a large delay time. Within the initial-value approach the first results are due to Wigner and Weisskopf, who showed that with certain approximations the decay law is exponential. More recently it has been argued by Höhler and others that the more correct law for decay of an unstable system is a sum of an exponential law and a power of t, i.e., t^{-3}. Such results rest on analytical properties of the resolvent of the energy operator, which are generally assumed or at most derived for simple models like the Lee model. Within the scattering problem approach on the other hand, it is possible to obtain some rigorous mathematical theorems as to the nature of the decay law. In particular, Khaflin has shown that there cannot be in principle an exponential decay law for all time t successive to the time at which the unstable system is initially prepared. A new analysis is given here of the initial-value approach. The Hilbert space of the system is subdivided into two orthogonal subspaces: the subspace to which the initial state belongs, and its orthogonal complement. The Schrödinger equation for the time evolution of the system is written as a set of coupled equations describing the time evolution in each of the subspaces. One can then decouple the two subspaces and show that the time evolution in the original subspace can be described by an equation simpler than the integro–differential equation obtained in the process. Such an equation is Schrödinger-like, but with a time-dependent and nonhermitian Hamiltonian, which is determined by an operator differential equation of the Ricatti type. The Ricatti-type equation can be easily solved when the original subspace is one-dimensional, i.e., the initial state is an eigenstate of the unperturbed Hamiltonian. It is found then that the initial state decays according to a sum of two exponentials. This decay law is seen to become an exact exponential decay law in the limit in which the lifetime of the initial state is very long. The case when the original subspace has higher dimensions than one and other applications of the new formalism are also indicated. (Diss. Abstr. Int., B)

XUM

PHYSICS (HIGH ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstract 25357.

25276 (UCSB-34-P-135-14) PROGRESS REPORT [ON HIGH ENERGY PHYSICS], MAY 1970-MARCH 1971. Caldwell, David O. (California Univ., Santa Barbara). Contract AT(04-3)-34. 16p. Dep. NTIS.

The research performed on high-energy interactions covers the total (γ,p) and (γ,n) cross sections up to 18 GeV, total photoabsorption cross sections for complex nuclei up to 18 GeV, high-energy inelastic Compton scattering, and the interaction of short-lived particles with nucleons. The computer facility is also discussed. A list of publications is included. (J.F.P.)

25277 SYMPOSIUM IN HONOR OF GIUSEPPE OCCHIALINI ON THE 20th ANNIVERSARY OF HIS RETURN TO ITALY, MILAN, ITALY, 10 OCTOBER 1968. Rend. Semin. Mat. Fis. Milano; 39: 1-288(1969). (In Italian and English). (CONF-681083).

The conference included 21 papers. Separate abstracts were prepared for 12 papers. (J.F.P.)

For abstracts of individual papers see: 23853, 24931, 25271, 25278, 25284, 25293, 25305, 25306, 25402, 25513, 25813, and 25814.

25278 PRESENT ROLE AND PROSPECTIVES OF COSMIC RAYS IN HIGH-ENERGY PHYSICS. Fenyves, Ervin. Rend. Semin. Mat. Fis. Milano; 39: 53-9(1969).

From Symposium in Honor of Giuseppe Occhialini on the 20th Anniversary of His Return to Italy, Milan, Italy. See CONF-681083.

It is suggested that the study of high-energy physics in cosmic radiation is limited to energies beyond 10^{12} to 10^{13} eV. These events are usually rare, and thus the results are qualitative rather than statistically verified. But these ideas can lead to discoveries in accelerator physics and vice-versa. Some concrete examples are given. (J.F.P.)

25279 SEARCH FOR RELATIVISTIC QUARKS IN COSMIC RAYS AT SEA LEVEL AND AT MOUNTAIN ALTITUDE. Chin, S.; Hanayama, Y.; Hara, T.; Higashi, S.; Tsuji, K. (Osaka City Univ.). Nuovo Cim.: 2A: 419-37(21 Mar 1971).

Using a telescope composed of 6 scintillation counters and 16 units of wire spark chambers with an aperture of 0.38 m^2 sr, fractionally charged particles (quarks) in cosmic rays were looked for at sea level for 2050 hours and then at mountain altitude for 5500 hours and the upper limits for the fluxes of quarks are set to be $I \leq 1.30 \cdot 10^{-10}$ cm^{-2} sr^{-1} s^{-1} at sea level and $I \leq 5.7 \cdot 10^{-11}$ cm^{-2} sr^{-1} s^{-1} at 2770 m altitude with 90% confidence level for relativistic particles with charge $\frac{1}{3}e$. The upper limits to the production cross sections were estimated as a function of the masses of quarks and of the assumed values for absorption mean free paths. If one assumes that the quark production cross sections are 1 μb and that the absorption mean free paths are 120 g cm^{-2}, then the lower limit of the mass of quarks is $M(\frac{1}{3}e) \geq 9.5$ GeV $\cdot$ c^{-2} from the mountain altitude data. (auth)

Electromagnetic

25280 (DESY-70/64) PHOTOPRODUCTION OF VECTOR MESONS. Wolf, Guenter (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Dec 1970. 67p. (CONF-700948-2). Dep. NTIS (U. S. Sales Only).

From Symposium on meson photo and electroproduction at low and intermediate energies; Bonn, Germany (21 Sep 1970).

The experimental data on the reactions $\gamma + p \rightarrow p + \rho(\omega)$ and $\gamma + p \rightarrow p + \phi$ are reviewed and compared with the vector dominance model predictions. (J.F.P.)

25281 (DESY-71/5) TOTAL PHOTOPRODUCTION CROSS SECTION OF HADRONS ON NUCLEI. Heynen, V.; Meyer, H.; Naroska, B.; Notz, D. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Feb 1971. 11p. Dep. NTIS (U. S. Sales Only).

The total cross section for photoproduction of hadrons $\sigma(\gamma A)$ was measured on 7 nuclei (Be, C, Al, Ti, Cu, Ag, and Au) at 5.4 GeV photon energy. In addition the energy dependence of $\sigma(\gamma A)$ was measured for Be, C, and Ti between 1.5 and 5.7 GeV. A small shadow effect is observed which is in reasonable agreement with the prediction of the vector dominance model. (auth)

25282 (UCRL-19890) BUBBLE CHAMBER STUDY OF POLARIZED $\gamma p \rightarrow \pi^+\pi^- p$ AT 2.8 AND 4.7 GeV. Moffeit, Kenneth Charles (California Univ., Berkeley. Lawrence Radiation Lab.). Nov 1970. Contract W-7405-eng-48. 153p. Dep. NTIS. Thesis.

A nearly monochromatic and linearly polarized photon beam produced by Compton backscattering of ruby laser light was used to study the reaction $\gamma p \rightarrow \pi^+\pi^- p$ at 2.8 and 4.7 GeV in a hydrogen bubble chamber. The cross sections for this reaction at 2.8 and 4.7 GeV are found to be 30.6 ± 1.2 and 19.9 ± 0.8 μb, respectively. Rho production and decay via $\gamma p \rightarrow \rho^0 p$ are studied and found to proceed almost completely through natural parity exchange. The contributions from unnatural parity exchange at 2.8 and 4.7 GeV are $3.1 \pm 3.1\%$ and $-1.1 \pm 2.8\%$, respectively, for momentum transfer $|t| < 1$ GeV^2. The behavior of the density matrix elements shows that the rho production mechanism conserves s-channel c.m.s. helicity for $|t| < 0.4$ GeV^2. The dependence of the ρ^0 mass shape on the momentum transfer is inconsistent with the Ross-Stodolsky factor. Evidence is presented for an interference of ρ^0 production with background. The data are compared with models including that of Söding, and the total and differential cross sections for ρ^0 production are presented. The $\rho^0-\omega$ interference parameters were measured. Assuming the ratio of the ρ^0 and ω photoproduction amplitudes $|A_\omega/A_\rho|^2 = 7.1$, $R_e(\delta e^{i\beta}) = 2.3 \pm 0.9$ MeV and $\mathrm{Im}(\delta e^{i\beta}) = -0.4 \pm 0.9$ MeV, where $\delta(\approx 2.3$ MeV) is the mass mixing parameter and $\beta(\approx -9^0)$ is the relative phase of the $\rho^0-\omega$ amplitudes were found. The production of $\Delta(1236)$ via $\gamma p \rightarrow \Delta^{++}\pi^-$ ($\Delta^0\pi^+$) was studied in the reaction $\gamma p \rightarrow \pi^+\pi^- p$. Cross sections and measurement of the parity asymmetry P_σ are presented; for Δ^{++} production with momentum transfer $|t_\Delta| < 0.5$ GeV^2 the values $P_\sigma = -0.27 \pm 0.12$ and -0.53 ± 0.15 at 2.8 and 4.7 GeV, respectively were found, whereas pure one-pion exchange would lead to $P_\sigma = -1$. (auth)

25283 PHOTOPRODUCTION OF ω-MESONS FROM 1.2 TO 8.2 GeV. Eisenberg, Y. (Weizmann Inst. of Science, Rehovoth, Israel); Haber, B.; Ronat, E. E.; (and others). Phys. Lett.; 34B: 439-42(15 Mar 1971).

The reaction $\gamma p \rightarrow \omega p$ was studied between 1.2 and 8.2 GeV using positron annihilation radiation. Assuming $\sigma \propto C_{OPE} \cdot E_\gamma^{-2} + C_{DIFF}$ the Pomeron exchange cross section was found to be (1.5 ± 0.3) μb. (auth)

25284 IS IT WORTHWHILE TO CONTINUE THE INVESTIGATION OF COSMIC-RAY JETS BY MEANS OF THE EMULSION METHOD? Gierula, J. Rend. Semin. Mat. Fis. Milano; 39: 60-5(1969).

From Symposium in Honor of Giuseppe Occhialini on the 20th Anniversary of His Return to Italy, Milan, Italy. See CONF-681083.

The value of the emulsion method for the analysis of cosmic-ray jets is considered. The viewpoint is taken that such emulsion studies of cosmic jets are worthwhile. It is pointed out that precise knowledge of the primary energy is not necessary to investigate some fundamental properties of multiple production processes, that large statistics can be ensured by a large volume of irradiated emulsions, and that the large admixture of very heavy nuclei in the target is useful in the case of production of a very short-lived intermediate state. (J.F.P.)

25285 PHOTOPRODUCTION OF K^+-HYPERON FROM HYDROGEN AND DEUTERIUM AT 11 GeV. Boyarski, A. M.; Diebold, R.; Ecklund, S. D.; (and others) (Stanford Univ., Calif.). Phys. Lett.; 34B: 547-50(29 Mar 1971).

Using an 11-GeV bremsstrahlung beam and the SLAC 20-GeV spectrometer, the K^+ missing mass spectra from hydrogen and deuterium was measured at five angles with momentum transfer squared ranging from 0.025 to 0.46 GeV^2. Steps in the spectra as a function of missing mass were found corresponding to production of Λ, Σ, Σ_{1385} + Λ_{1405} and Λ_{1520}. The ratio Σ^- to Σ^0 production is not consistent with pure isotopic spin $\frac{1}{2}$ in the t-channel for the reaction $\gamma N \rightarrow K^+\Sigma$. The cross sections for $\gamma N \rightarrow K^+\Sigma_{1385}$ compared with $\gamma N \rightarrow \pi\Delta$ violate an SU(3) prediction. (auth)

25286 SEARCH FOR STRANGENESS S = +1 BARYON STATES. Hughes, Vernon W. (Yale Univ., New Haven). pp 349-66 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

Two experiments are described in which a search is made for Z particles. The first experiment was the photoproduction of K^- in $\gamma + p$ interactions. It is found that the results are inconclusive regarding the establishment of the existence of Z particles. The second experiment was a study of the elastic scattering of K^+ mesons by polarized protons at 2.0 GeV/c. The asymmetry for this reaction is shown. It is hoped that the extensive data will help to clarify the question of the existence of S = +1 baryon states. (J.F.P.)

25287 NEUTRAL DECAY MODES OF THE η^0 PARTICLE. Strugalski, Z. S.; Chuvilo, I. V.; Gemesy, T.; (and others) (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys.; B27: 429-36(1971).

Results of an investigation of the η^0 meson decay modes $\eta^0 \rightarrow \gamma\gamma$, $\eta^0 \rightarrow \pi^0\gamma\gamma$ and $\eta^0 \rightarrow 3\pi^0$ are presented. The branching ratios of the neutral decay modes were evaluated. (auth)

Weak

25288 (COO-1195-206) TEST OF THE $\Delta S = \Delta Q$ SELECTION RULE IN K^*_{l3} DECAY. Graham, Michael Francis (Illinois Univ., Urbana). Jun 1971. Contract AT(11-1)-1195. 129p. Dep. NTIS.

Thesis.

An experiment was performed at the Argonne National Laboratory ZGS to test the $\Delta S = \Delta Q$ selection rule in K^*_{l3} decay. The theoretical time distribution for K^*_{l3} decays contains a complex parameter x'. A nonzero value of x' implies a violation of the $\Delta S = \Delta Q$ rule, and a nonzero value of Im(x') implies a violation of CP symmetry. K^*'s were obtained from 3.0 GeV/c negative pions striking a carbon target giving the reaction $\pi^-p \rightarrow \Lambda K^*$. Counters, optical spark chambers, and a spectrometer magnet were used to record K^*_{l3} decays on film for reconstruction on a computer. The detection of the proton from $\Lambda \rightarrow \pi^-p$ was used as a trigger requirement to indicate associated production of the K^*. The muon from the K^*_{l3} decay was detected by counters placed behind a steel absorber used to suppress K^*_{e3} background. A sample of K^*_{l3} events decaying between 0.5 and 6.5 K^0_S lifetimes was obtained. A fit to the data with the theoretical time distribution corrected for experimental detection efficiency was made. Maximum likelihood was used to obtain the best estimators of the parameters Re(x') and Im(x') of the theoretical distribution. The results obtained for 100 events were: $Re(x') = 0.4^{+.10}_{-.13}$, $Im(x') = .12^{+.17}_{-.16}$. These results are consistent with the $\Delta S = \Delta Q$ rule and CP symmetry. (auth)

25289 (COO-1195-207) SEARCH FOR THE DECAY $K^0_S \rightarrow \pi^+\pi^-\pi^0$. Jones IV, Lewis Hammond (Illinois Univ., Urbana). Feb 1971. Contract AT(11-1)-1195. 142p. Dep. NTIS.

Thesis.

A spark chamber experiment was run at Argonne National Laboratory to search for the decay $K^0_S \rightarrow \pi^+\pi^-\pi^0$. CP does not forbid this decay, but the CP conserving states are strongly suppressed by centrifugal barriers. Therefore, observation of a large amplitude for $K^0_S \rightarrow \pi^+\pi^-\pi^0$ would indicate probably CP violation in this decay mode. The method used was to measure the time distribution of $K^0_S \rightarrow \pi^+\pi^-\pi^0$ decays in the region from 0.5 to 6.5 K^0_S lifetimes. The K^0 mesons were produced in a 3-cm. long carbon target via the reaction $\pi^-p \rightarrow K^0\Lambda$ at a beam momentum of 3 GeV/c. Identification of the Λ insured that there was no $\bar{K}^0$ contamination in the data at t = 0. The momenta of the charged decay products were measured using thin foil spark chambers placed in a 10 kG magnetic field. Photons from π^0 decay were identified by observation of showers in heavy-plate spark chambers. Two charged particle tracks and one photon track, consistent with $K^0_{\pi 3}$ decay, were required. The time distribution for the 99 events in the final sample was fit by the method of maximum likelihood for the complex amplitude ratio $x + iy = (K^0_S \rightarrow \pi^+\pi^-\pi^-)/(K^0_L \rightarrow \pi^+\pi^-\pi^0)$. The result is $x = -0.09 \pm 0.19$, $y = 0.56 \pm 0.43$. This result indicates a possible violation of CP in K^0_{l3} decays but is also consistent with CP conservation at the one standard deviation level. The value of χ^2 for x = y = 0 is 6.10 for four degrees of freedom with χ^2 probability = 19.2%. A second result found in the likelihood fit is statistically preferred over the first result but is ruled out on theoretical and experimental grounds. (auth)

25290 (COO-1195-208) TEST OF THE $\Delta S = \Delta Q$ SELECTION RULE IN K^*_{l3} DECAY. Graham, M. F.; Abashian, A.; Jones, L. H.; Mantsch, P. M.; Orr, J. R.; Smith, J. H.; Stutzke, R. D. (Illinois Univ., Urbana); Glaubman, M. J. (Northeastern Univ., Boston, Mass.). Feb 1971. 11p. Dep. NTIS.

A test of the $\Delta S = \Delta Q$ selection rule in K^*_{l3} decay was performed using optical spark chambers. K^* mesons were produced by 3-GeV/c π^- in the reaction $\pi^-p \rightarrow \Lambda K^*$. There were 100 events with proper decay times between 0.5 and 6.5 K^0_S lifetimes analyzed to give a ratio of the $\Delta S = -\Delta Q$ to $\Delta S = \Delta Q$ amplitudes $Re(x') = 0.04^{+.10}_{-.13}$, $Im(x') = 0.12^{+.17}_{-.16}$. (auth)

25291 (COO-1195-209) SEARCH FOR THE DECAY $K^0_S \rightarrow \pi^+\pi^-\pi^0$. Jones, L. H.; Abashian, A.; Graham, M. F.; Mantsch, P. M.; Orr, J. R.; Smith, J. H.; Stutzke, R. D. (Illinois Univ., Urbana); Glaubman, M. J. (Northeastern Univ., Boston, Mass.). Feb 1971. Contract AT(11-1)-1195. 13p. Dep. NTIS.

An optical spark chamber experiment was performed to search for the decay $K^0_S \rightarrow \pi^+\pi^-\pi^0$. K^0 mesons were produced by 3 GeV/c π^- in the reaction $\pi^-p \rightarrow AK^0$. There were 99 events with decay times between 0.5 and 6.5 K^0_S lifetimes analyzed to give x + iy, the ratio of the amplitude $K^0_S \rightarrow \pi^+\pi^-\pi^0$ to the amplitude $K^0_L \rightarrow \pi^+\pi^-\pi^0$. The values $x = -0.09 \pm 0.19$ and $y = 0.56 \pm 0.43$ were obtained. (auth)

25292 (COO-1195-210) A TEST OF THE $\Delta S = \Delta Q$ SELECTION RULE IN K^*_{e3} DECAY. Mantsch, P. M.; Abashian, A.; Graham, M. F.; Jones, L. H.; Orr, J. R.; Smith, J. H.; Stutzke, R. D. (Illinois Univ., Urbana); Glaubman, M. J. (Northeastern Univ., Boston, Mass.). Feb 1971. Contract AT(11-1)-1195. 10p. Dep. NTIS.

An optical spark chamber experiment was performed to test the validity of the $\Delta S = \Delta Q$ weak interaction selection rule for the decay $K^*(\bar{K}^*) \rightarrow \pi^+e^-\nu$. Analysis of the time distribution of 342 decays has given the complex ratio, x, of the $\Delta S = -\Delta Q$ to $\Delta S = \Delta Q$ amplitudes to be $Re(x) = -0.13 \pm 0.11$ and $Im(x) = -0.04 \pm 0.16$ which is consistent with no violation of the $\Delta S = \Delta Q$ rule. (auth)

25293 WEAK DOUBLE PION PRODUCTION. Bottino, Alessandro; Ciocchetti, Guido; Franzinetti, Carlo. Rend. Semin. Mat. Fis. Milano; 39: 127-43(1969).

From Symposium in Honor of Giuseppe Occhialini on the 20th Anniversary of His Return to Italy, Milan, Italy. See CONF-681083.

The existing experimental knowledge on weak double pion production is summarized and various theoretical models attempted so far are discussed. The observations of neutrino inelastic events show that double pion production takes place with a cross section of the order of about 10^{-39} cm^2. It is found that diffractive and peripheral mechanisms play only a minor role and that resonance formation followed by a resonance-cascade is a model which correctly predicts the main features. (J.F.P.)

25294 DEPENDENCE OF NEUTRINO-NUCLEUS CROSS SECTIONS ON THE NUCLEON NUMBER OF THE TARGET NUCLEUS. Seiler, P.-G.; Borer, K.; Hahn, B.; Hofer, H.; Krienen, F. Helv. Phys. Acta; 43: 845-64(1970). (In German).

The dependence of total cross sections on the mass number A for high energy neutrino interactions was investigated. A spark chamber setup containing targets of C, Al, Fe and Pb was exposed to the CERN neutrino beam. For $\theta_{\nu\mu} \leq 29°$ and $q^2 \approx 0.3$ (GeV/c)^2 the cross sections are proportional to A. A restricted sample of events with $\theta_{\nu\mu} < 5°$ and $q^2 \lesssim 0.1$ (GeV/c)^2 leads to an A-dependence which lies between A- and $A^{\frac{1}{3}}$-proportionality, but due to the small number of events in this sample neither pure A-proportionality nor 65% $A^{\frac{1}{3}}$ contribution can be excluded. (auth)

25295 FURTHER OBSERVATIONS ON SCALING IN NEUTRINO INTERACTIONS. Myatt, G.; Perkins, D. H. (Oxford Univ.). Phys. Lett.; 34B: 542-6(29 Mar 1971).

Analysis of bubble chamber neutrino events indicates that the Bjorken scaling formula applies in the low energy region if the cross sections are expressed in terms of the Bloom-Gilman parameter $x' = q^2/(2M\nu + M^2)$. The value of $\int F_2 dx'$ averaged over neutrons and protons is compatible with the electron data, CVC and pure V, A coupling for the nucleon constituents, provided isoscalar contributions are small. Limits are placed on the relative magnitudes of F_1, F_2 and F_3. (auth)

Strong (Baryon-Induced)

Refer also to abstracts 23855 and 25432.

25296 (IFVE-SEF-70-38) PRODUCTION OF LOW MOMENTUM NEGATIVE PARTICLES BY 70 GeV PROTONS. Antipov, Yu. M.; Vishnevskii, N. K.; Gorin, Yu. P.; (and others) (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1970. 10p. (In Russian). NTIS (U. S. Sales Only).

The yields of negative pions, kaons, antiprotons, and antideuterons, produced by 70 GeV protons on Al and Be nuclei at the momenta 10 and 13.3 GeV/c were measured. Gas Cherenkov counters and time-of-flight spectrometers were used for particle identification. (auth)

25297 (JINR-P1-5571) COMPARISON OF EXPERIMENTAL RESULTS ON MESON PRODUCTION IN pp COLLISIONS AT 660

XUM

MeV WITH THE OPE MODEL PREDICTIONS. Zul'karneev, R. Ya.; Ovchinnikov, B. M.; Poltavskaya, N. A.; Fedorov, O. Ya. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1971. 13p. (In Russian). Dep. NTIS (U. S. Sales Only).

The results of experimental studies of the $pp \rightarrow \pi^+np$, π^0pp reactions in the 600 to 660 MeV region are compared with the predictions of the Sellery meson-production model. A qualitative agreement with the experimental data is found. (auth)

25298 (JINR-P1-5592) CHARACTERISTICS OF SECONDARY PARTICLES EMITTED IN π^+ Xe COLLISIONS AT 2.34 GeV/c. Slovinskii, B.; Strugal'skii, Z. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1971. 17p. (In Russian). Dep. NTIS (U. S. Sales Only).

The effective masses of different pairs of particles: γ-quanta, π_0^+ -mesons and protons, emitted in π^+Xe interactions at 2.3 GeV/c, were studied. The angular and momentum distributions of protons, emitted in these reactions, are presented. (auth)

25299 (NP-18730) STUDY OF THE ANNIHILATIONS $\bar{p}p \rightarrow 2\pi^+\pi^-(\pi^0)$ AT 3.6 GeV/c. Debray, Josette (Paris Univ. (France). Faculte des Sciences). 1970. 71p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The mass spectra of the $\bar{p}p$ annihilations into 4 or 5 π at 3 GeV/c were studied. The cross sections for the production of the ρ, f^0, and ω^0 resonances in the annihilations $\bar{p}p \rightarrow 2\pi^+2\pi^-$ and the effective mass spectrum of the $\pi^+\pi^-$ in the final state were derived. A bump appeared between 1500 and 1700 MeV and it was attributed to the g(1660) meson. Final states in which two resonances are produced were shown to exist; 25 percent of the final states in the $\bar{p}p \rightarrow 2\pi^+2\pi^-$ reaction consist of two resonant $\pi\pi$ systems; 21 percent of the final states in the $\bar{p}p \rightarrow 2\pi^+2\pi^-\pi^0$ reaction are three-body systems among which two resonances were found. A search for heavy resonances was made, and significant evidence of the existence of objects with high masses decaying into three or four pions was obtained. The experimental data were compared with the predictions of the multiregge CHAN model. (France)

25300 ELASTIC BACKWARD SCATTERING OF FAST PROTONS BY LIGHT NUCLEI. Komarov, V. I.; Kosarev, G. E.; Savchenko, O. V. (Joint Inst for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 12: 1229-32(Dec 1970). (In Russian).

The upper limit for the cross sections of 665-MeV proton elastic scattering by the ^{6}Li nucleus at the angle 169° in c.m.s. is determined experimentally. Possible mechanisms of 100 to 1000 MeV proton backward elastic scattering by deuterons ^{3}He, ^{4}He and ^{6}Li, are discussed. (auth)

25301 MOMENTUM TRANSFER DEPENDENCE OF NUCLEON RESONANCE PRODUCTION IN PROTON-PROTON COLLISIONS AT 24 GeV/c. Amaldi, U. (Istituto Superiore di Sanita, Rome. INFN, Rome); Biancastelli, R.; Bosio, C.; (and others). Phys. Lett.; 34B: 435-8(15 Mar 1971).

Nucleon resonance production in the two-body reaction $p + p \rightarrow p + N^*$ was studied at 24 GeV/c incident momentum for angles from 12 to 117 mrad by measuring proton momentum spectra from the elastic peak down to a momentum corresponding to a missing mass of about 2.6 GeV. (auth)

25302 ENERGY DEPENDENCE OF THE STRUCTURE IN HIGH ENERGY PROTON-PROTON ELASTIC SCATTERING. Allaby, J. V. (CERN, Geneva); Diddens, A. N.; Robinson, R. W.; (and others). Phys. Lett.; 34B: 431-4(15 Mar 1971).

The angular distribution of proton-proton elastic scattering was measured for incident beam momenta of 10.0, 12.0, 14.2, and 24.0 GeV/c over a range of laboratory scattering angles from 12 to about 140 mrad. The results are compared with the fourth power of the electromagnetic form factor of the proton. (auth)

25303 NEUTRON-PROTON ELASTIC SCATTERING FROM 5 TO 30 GeV/c. Gibbard, Bruce Gregory. Ann Arbor, Mich.; Univ. of Michigan (1970). 130p. University Microfilms Order No. 71-4611.

Thesis.

The differential cross section for neutron-proton elastic scattering was measured in the diffraction region with incident neutron momenta between 4 and 30 GeV/c. The experiment was an optical spark chamber-counter experiment conducted at the Brookhaven National Laboratory Alternating Gradient Synchrotron. A well-collimated multi-energetic neutron beam was incident on a liquid hydrogen target. The scattered neutron was detected in a thick plate spark chamber array while the recoil proton was detected and momentum analyzed in a thin plate spark chamber-magnet spectrometer. The results indicate that the neutron-proton cross sections are very similar to but not identical to the proton-proton cross sections. The diffraction peak in the neutron-proton system does show shrinkage with increasing incident momentum but is devoid of auxiliary structure. (Diss. Abstr. Int., B)

25304 PROTON-NEUTRON ELASTIC SCATTERING FROM DEUTERIUM. Marshak, Marvin Lloyd. Ann Arbor, Mich.; Univ. of Michigan (1970). 69p. University Microfilms Order No. 71-4673.

Thesis.

The feasibility of measuring the ratio of proton-neutron to proton-proton elastic scattering using the 2nd extracted proton beam of the Argonne ZGS and a liquid deuterium target was tested. The forward proton was detected by a 35 m long spectrometer consisting of magnets and scintillation and Cherenkov counters. The recoil nucleon was detected by a steel-scintillator sandwich counter. The efficiency of this counter was measured using tagged neutrons in coincidence with the spectrometer and calculated using a Monte Carlo simulation of the nuclear cascade. A scintillation counter determined whether the recoil nucleon was charged or neutral. At a test point of $P_0 = 12.4$ GeV/c, $\theta^* = 37°$ and $t = 2.2$ $(GeV/c)^2$, a pn to pp cross section ratio of 1.05 ± 0.14 was found. The pp cross section was $(d\sigma/d\Omega)_{cm} = 5.8 \pm 0.6$ μb/sr and the pn cross section was $(d\sigma/d\Omega)_{cm} = 6.1 \pm 1$ μb/sr. The ratio of pp scattering from deuterium to pp scattering from hydrogen corrected for geometrical effects was 0.75 ± 0.09. The future of this technique for measuring pn cross sections is discussed, and the results of the test are compared with the predictions of the Glauber multiple scattering formalism. Also, available pn data are plotted as a function of $\beta_{cm}^2 p_{\perp}^2$. (Diss. Abstr. Int., B)

25305 TRIPLETS AND CONSEQUENCES. Sitte, Kurt. Rend. Semin. Mat. Fis. Milano; 39: 66-70(1969).

From Symposium in Honor of Giuseppe Occhialini on the 20th Anniversary of His Return to Italy, Milan, Italy. See CONF-681083.

The hypothesis of the existence of heavy triplets in the cosmic radiation is considered. The experimental properties and their consequences for these particles are discussed. (J.F.P.)

25306 DO THE Z* HYPERONS, WITH STRANGENESS +1, EXIST? Goldschmidt-Clermont, Yves. Rend. Semin. Mat. Fis. Milano; 39: 71-84(1969).

From Symposium in Honor of Giuseppe Occhialini on the 20th Anniversary of His Return to Italy, Milan, Italy. See CONF-681083.

An experiment to detect the Z* is reviewed in the framework of other such attempts. These Z* baryons are searched for in a production experiment, but they are not found. Upper limits are given for their production cross sections. (J.F.P.)

25307 PROPERTIES OF $\Sigma(1660)$ OBSERVED IN FORMATION EXPERIMENTS. Plane, D. E. (CERN, Geneva). pp 283-7 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

A review is given of the mass and width of the $\Sigma(1660)$ from partial-wave analyses of $K^- + p \rightarrow \Sigma + \pi$ interactions. Also the branching ratios are given for decays into $\bar{K}N^*$, ΣN^*, ΛN^*, $\Sigma\pi\pi$, and $\Lambda\pi\pi$. (J.F.P.)

25308 COMMENTS ON THE $\Sigma(1620)$. Garfinkel, Arthur F. (Purdue Univ., Lafayette, Ind.). pp 301-3 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

A brief review of the $\Sigma(1620)$ produced in K^- + n interactions is given. The mass spectra and branching ratios for the $\Sigma(1620)$ decays are discussed. (J.F.P.)

25309 Ξ STATES. Kalbfleisch, George R. (Brookhaven National Lab., Upton, N. Y.). pp 331-45 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

The Ξ states are reviewed. The importance of the cascade states, some representative data, and the isotopic spin of these resonances are discussed. Also a list of the Ξ states with the notations of certain, reasonable, or indicated is given. (J.F.P.)

Strong (Meson-Induced)

Refer also to abstract 25449.

25310 (ORO-2504-170) AN ANALYSIS OF THE YK$\bar{K}$ AND $\Xi^0K^+\pi^-$ THREE BODY FINAL STATES FROM K^-p INTERACTIONS AT 2.9 GeV/c. Stottlemyer, Alan Roy (Maryland Univ., College Park. Dept. of Physics and Astronomy). Feb 1971. 99p. Dep. NTIS.

Thesis.

The three body final states $\Lambda^0K\bar{K}$, $\Sigma K\bar{K}$, and $\Xi^0K^+\pi^-$ produced by K^-p interactions have been analyzed at a K^- beam momentum of 2.9 GeV/c. This is a part of the analysis of a 40 event/microbarn exposure of K^- mesons in hydrogen being studied by the Brandeis-Maryland-Syracuse-Tufts collaboration. The primary purpose of the experiment is a study of strangeness -2 baryon states at a single momentum. Evidence is presented for the existence of at least one such resonance with a mass of about 1860 MeV. There is a large sample of ϕ mesons, produced in both the $\Lambda^0\phi$ and $\Sigma^0\phi$ final states. The mass and width of the ϕ have been measured, and the results are compatible with existing data. The $\Lambda\phi$ and $\Sigma^0\phi$ production t distributions are given, illustrating a possible difference in the production mechanisms for the two final states. The production cross sections are determined for all reactions presented. The effective exposure is about 30 events/microbarn for the $\Lambda^0K^0\bar{K}^0$, $\Sigma^0K^-K^0$, and $\Sigma^-K^+\bar{K}^0$ final states, and about 5 events/microbarn for the $\Lambda^0K^+K^-$, $\Sigma^0K^+K^-$, and $\Xi K^+\pi^-$ final states. (auth)

25311 (UCRL-20248) K^+d INTERACTIONS FROM 865 TO 1365 MeV/c. Hirata, Allan Akira (California Univ., Berkeley. Lawrence Radiation Lab.). Oct 1970. Contract W-7405-eng-48. 123p. Dep. NTIS.

Thesis.

Some detailed experimental results are presented on the K^+d interactions from 865 to 1365 MeV/c incident beam momentum. Measurements on several K^+d partial cross sections are presented, and most of the others are calculated using relations derived from isospin conservation and data from other experiments. The most striking feature of the cross section data is the abrupt rise of the total single-pion-production cross section near 1200 MeV/c. Also isospin-0 KN partial cross sections are extracted, and a rapid increase of $\sigma_0(KN\pi)$ at the threshold for the quasi-two-body reaction $KN \rightarrow K^*N$ is found. As in the case of the isospin-1 K^+N system, it appears that the structure around 1200 MeV/c in the total cross section for the isospin-0 K^+N system is well reconstructed by the sum of three smoothly varying, non-peaked channel cross sections $\sigma_0(KN)$, $\sigma_0(KN\pi)$, and $\sigma_0(KN\pi\pi)$. The charge exchange data are compared with the predictions of a Regge model and they are found to be consistent with the results of high-energy fits. The reaction $KN \rightarrow K^*N$ near threshold is studied and it is found that the data can be easily interpreted in terms of t-channel phenomena. (auth)

25312 (UR-875-332) REVIEW OF STRANGE MESONS. Slattery, P. (Rochester Univ., N. Y. Dept. of Physics and Astronomy). 1 Jan 1971. Contract AT(30-1)-875. 53p. (CONF-701108-4). Dep. NTIS.

From Meeting of the Division of Particles and Fields of the American Physical Society; Austin, Tex. (5 Nov 1970).

The review of strange mesons covers the $K\pi\pi/K\pi$ decay branching ratio of the K^*, evidence for the existence of possible substructure in the Q region, a review of the L region, and evidence for the existence of additional strange mesons. (J.F.P.)

25313 CROSS SECTIONS FOR PRODUCTION OF NEUTRAL FINAL STATES IN π^-p INTERACTIONS AT 5 GeV/c. Budagov, Yu. A.; Vinogradov, V. B.; Volodko, A. G.; (and others). Yadern. Fiz.; 12: 1222-8(Dec 1970).

Cross sections for the reactions $\pi^-p \rightarrow n + (1,2,3,4,5)\pi^0$, $\pi^-p \rightarrow n + \eta^0(\eta^0 \rightarrow 2\gamma)$, $\pi^-p \rightarrow n + f^0$ ($f^0 \rightarrow 2\pi^0$), and $\pi^-p \rightarrow \pi^0 + N^{*0}(1236)$ ($N^{*0} \rightarrow n + \pi^0$) are measured at the incident pion momentum of 5 GeV/c by means of the 1-m propane bubble chamber at JINR. The incident momentum dependence of the cross sections is discussed. (auth)

25314 ANTI-LAMBDA PRODUCTION IN π^-p INTERACTIONS AT 20 GeV/c. Balea, E.; Balea, O.; Berceanu, S.; (and others) (Inst. of Atomic Physics, Bucharest). Rev. Roum Phys.; 15: 1035-8(1970).

A search is performed for $\bar{\Lambda}$ production in π^-p interactions at 20 GeV/c in hydrogen bubble chamber. The production cross section is estimated to be 7.2 μb. A comparison with other experimental results is given. (auth)

25315 NEW SPIN-PARITY ANALYSIS OF THE $\varphi(1680)$ MESON. Matthews, J. A. J. (Univ. of Toronto); Prentice, J. D.; Yoon, T. S.; (and others). Lett. Nuovo Cim.; 1: 361-5(27 Feb 1971).

The $\varphi(1680)$ meson in the interactions $\pi^+ + d \rightarrow 2p + \pi^+ + \pi^- + \pi^0$ at 6.95 GeV/c in a deuterium bubble chamber was studied. The mass and width of the $\varphi(1680)$ were found to be 1.679 + 0.017 and 0.155 + 0.020 GeV respectively. An analysis of the Dalitz plot distributions of events in the $\varphi(1680)$ favors a natural spin-parity assignment for this resonance. The mass and favored natural spin-parity suggest that the $\varphi(1680)$ may be Regge recurrence of the ω^0 or a member of the predicted $J^P = 1^-$ quark model nonet. (J.F.P.)

25316 $n\pi^-\pi^-$ MASS DISTRIBUTION IN THE REACTION $K^-d \rightarrow \bar{K}^0\pi^+\pi^-\pi^-n(p_s)$ AT 5.5 GeV/c. Johnson, D. (Argonne National Lab., Ill.). Phys. Lett.; 34B: 428-30(15 Mar 1971).

The reaction $K^-d \rightarrow \bar{K}^0\pi^+\pi^-\pi^-n(p_s)$ was studied at 5.5 GeV/c K^- momentum. No evidence is seen for the recently reported $n\pi^-\pi^-$ mass enhancement at 1630 MeV. (auth)

25317 f^0 MASS SPECTRUM IN 7-GeV/c π^+p INTERACTIONS. Flatte, S. A.; Alston-Garnjost, M.; Barbaro-Galtieri, A.; (and others) (Univ. of California, Berkeley). Phys. Lett.; 34B: 551-3(29 Mar 1971).

Structure in the f^0[an SU(3) companion of the A_2] is sought in more than 5000 $\pi^+p \rightarrow f^0\Delta^{++}$ events at 7 GeV/c in a hydrogen bubble chamber. The mass spectrum and the moments of the decay angular distribution are studied with a resolution of 7.8 MeV. (auth)

25318 EVIDENCE AGAINST AN $n\pi^-\pi^-$ ENHANCEMENT AT A MASS OF 1.627 GeV/c^2 IN $K^-d \rightarrow p_s\,\pi^-\pi^-\pi^-n\,\bar{K}^0$ AT 4.48 GeV/c. Ammann, A. C. (Purdue Univ., Lafayette, Ind.); Carmony, D. D.; Garfinkel, A. F.; (and others). Phys. Lett.; 34B: 533-4(29 Mar 1971).

Recently evidence was presented for the production of an $n\pi^-\pi^-$ enhancement of mass 1627 MeV/c^2 in the reaction $K^-d \rightarrow p_s\,\pi^+\pi^-\pi^-n\,\bar{K}^0$. With greater statistics, the data for the same reaction at nearly the same energy fail to show any evidence for such a resonance. (auth)

25319 KAON-NUCLEON TOTAL CROSS SECTIONS FROM 0.36 TO 0.72 GeV/c. Bowen, T.; Caldwell, P. K.; Dikmen, F. Ned; (and others) (Univ. of Arizona, Tucson). pp 3-8 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

The total cross sections for $K^+ + p$ and $K^+ + d$ interactions at 360 to 720 MeV/c were measured by the transmission counter technique. These cross sections are shown. (J.F.P.)

25320 COMMENTS ON THE SCATTERING OF K^+ MESONS IN THE ISOSPIN ZERO STATE. Cool, Rodney L. (Brookhaven National Lab., Upton, N. Y.). pp 47-52 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

The cross sections for $K^+ + p$ and $K^+ + d$ interactions in the isospin-zero state are discussed. These interactions take place below 2 GeV/c. (J.F.P.)

25321 INVESTIGATION OF THE $Y\pi$ PARTIAL WAVE AMPLITUDES BELOW $\bar{K}N$ THRESHOLD USING $\bar{K}D$ REACTIONS. Cline, D.; Laumann, R.; Mapp, J. (Univ. of Wisconsin, Madison). pp 71-7 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

The results of a study of angular distributions and $Y\pi$ mass spectra for the reactions $K^- + d \rightarrow \Lambda(\Sigma^0) + \pi^- + p$ and $K^- + d \rightarrow \Sigma^+(\Sigma^-) + \pi^-(\pi^+) + n$ are presented. These reactions took place at a K^- beam momentum of 400 MeV/c in a bubble chamber. The $\Sigma(1385)$, $\Lambda(1405)$, and $\Lambda(1520)$ were observed. It is concluded that these reactions can be used to probe the $Y\pi$ partial-wave amplitude region below the KN threshold directly. (J.F.P.)

25322 STUDY OF THE I = 1 REACTION $K^-n \rightarrow \Sigma^1\pi^1\pi^-$ FROM 1585 TO 1735 MeV. Brucker, E. B.; Harrison, W. C.; Sims, W. H.; (and others) (Florida State Univ., Tallahassee). pp 155-60 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

The reaction $K^- + n \rightarrow \Sigma^-(\Sigma^+) + \pi^-(\pi^+) + \pi$ was studied at energies from 678 to 835 MeV/c in a deuterium bubble chamber. Differential and total cross sections were found for these interactions. The resonances produced were $\Sigma(1770)$, an $\Lambda(1405)\pi$ enhancement at 1681 MeV with a width of 30 MeV, $\Sigma(1385)$, $\Lambda(1405)$, and $\Lambda(1520)$. The branching ratio for $\Sigma(1660) \rightarrow \Lambda(1405) + \pi$ decay is also found. (J.F.P.)

25323 REACTION $K^-p \rightarrow \Lambda\pi^0$ IN THE E^* RANGE 1915 TO 2168 MeV. pp 205-10 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

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From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

The reaction $K^- + p \rightarrow \Lambda + \pi^0$ was studied in a bubble chamber in the momentum range 1.26 to 1.84 GeV/c. The cross sections and production of the Σ(2030), Σ(1770), and Σ(1910) are discussed. The parity of the Σ(2030) and the Σ(1910) is found. (J.F.P.

25324 REACTIONS $K^-p \rightarrow \Sigma^\pm\pi^\mp$ IN THE E* RANGE 1915 TO 2168 MeV. pp 211-13 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

A study of the reactions $K^- + p \rightarrow \Sigma^+(\Sigma^-) + \pi^-(\pi^+)$ at 1.26 to 1.84 GeV/c in a hydrogen bubble chamber was made. Angular distributions are described, and Y* resonance production is studied. (J.F.P.)

25325 K^-p ELASTIC DIFFERENTIAL CROSS SECTION MEASUREMENTS BETWEEN 1.7 AND 2.5 GeV/c. Barber, P. C. (University Coll., London); Broome, T. A.; Busza, W.; (and others). pp 223-6 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

Elastic differential cross sections for $K^- + p$ interactions at 1.1 to 2.5 GeV/c are measured. These differential cross sections are shown. (J.F.P.)

25326 OBSERVATION OF Σ RESONANCES IN THE 1670 MeV MASS REGION. Aguilar-Benitez, M. (Brookhaven National Lab., Upton, N. Y.); Barnes, V. E.; Bassano, D.; (and others). pp 273-8 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

The resonance $\Sigma^+(1670)$ production is studied in the reactions $K^- + p \rightarrow \Sigma^+(\Sigma^-) + \pi^-(\pi^+) + \pi^+ + \pi^-$, $K^- + p \rightarrow \Sigma^0(\Lambda) + \pi^+ + \pi^-$, and $K^- + p \rightarrow p + \bar{K}^0 + \pi^-$ at 3.9 and 4.6 GeV/c in a hydrogen bubble chamber. The mass spectra are shown for these interactions. It is found that there are at least two resonances in the 1670-MeV mass region. (J.F.P.)

25327 FORWARD PRODUCTION OF I = 0 HYPERONS IN THE REACTION $K^-n \rightarrow Y\pi^-$ AT 3 GeV/c. pp 289-93 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

The reaction $K^- + n \rightarrow Y_0^* + \pi^-$ at 3 GeV/c is studied. Mass and angular distributions are shown for this reaction. The $Y_0^*K^-p$ coupling constant from this reaction is also discussed, and the properties of the Y_0^* resonances are tabulated. (J.F.P.)

25328 REACTION $K^-n \rightarrow Y_0^*\pi^-$ AT 5.0 TO 5.5 GeV/c. pp 295-9 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

A compilation of data on low-mass Y_0^* resonances which decay to $\Sigma^-(\Sigma^+) + \pi^+(\pi^-)$, $p(n) + K^-(\bar{K}^0)$ final states in $K^- + n$ interactions is presented. Emphasis is given to the production and decay of Λ(1520). Mass and angular distributions are shown. (J.F.P.)

25329 OBSERVATION OF Ξ* RESONANCES IN 5.5 GeV/c K^-p INTERACTIONS. Schultz, P. F. (Univ. of Illinois, Urbana). pp 313-16 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

The four- and five-body final-states of $K^- + p$ interactions at 5.5 GeV/c were studied for evidence of Ξ* resonances. The resonances Ξ*(1530), Ξ*(1930), Ξ*(1820), and also a very narrow structure $\Xi^-\pi^+\pi^-(2295)$ were observed. (J.F.P.)

25330 Ξ RESONANCES BELOW 2 GeV. pp 317-30 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

Further results of an extensive search for Ξ resonances below 2 GeV from a hydrogen bubble chamber exposed to a beam of 2.9-GeV/c negative kaons are presented. The data are compared with those of previous work, and a critique of the situation below 2 GeV is given. The mass spectra observed mass, and width, and branching ratios of the Ξ* are shown. (J.F.P.)

25331 K^+p ELASTIC SCATTERING BETWEEN 1.4 AND 2.3 GeV/c. Barber, P. C. (University Coll., London); Broome, T. A.; Duff, B. G.; (and others). pp 453-5 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

The differential cross sections for $K^+ + p \rightarrow K^+ + p$ interactions were measured between 1.4 and 2.3 GeV/c. A phase shift analysis was carried out using the new data and all other published data. Two continuous solutions were obtained from 0 to 2.2 GeV/c. In the first solution no resonance structure is observed in any partial wave, and the second solution shows the same P_{13} "resonant" behavior obtained previously. (J.F.P.)

25332 K^+p INTERACTIONS IN THE RANGE 0.9 TO 1.5 GeV/c AND ELASTIC SCATTERING PHASE SHIFT ANALYSIS. pp 457-61 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

An observation of $K^+ + p$ interactions at 0.9 to 1.5 GeV/c was made using a bubble chamber. Total, total elastic, and partial inelastic cross sections and elastic scattering angular distributions were measured. Also a phase shift analysis was carried out using $K^+ + p$ total, total inelastic, elastic differential cross sections and recoil proton polarization in elastic scattering. The preferred solutions show resonance-like behavior or the P_{13} amplitude. (J.F.P.)

25333 STRANGE-PARTICLE PRODUCTION IN 7 GeV/c π^-p INTERACTIONS. Peekna, A. (Univ. of Wisconsin, Madison); Walker, W. D.; Oh, B. Y.; (and others). Nucl. Phys.; B27: 605-14 (1971).

Various cross sections are presented. Data on quasi-two-body reactions are found to be generally consistent with the Regge-pole model. There are some indications that the highest-lying trajectory does not always exclusively dominate at this energy. (auth)

25334 K^-p INTERACTIONS FROM 450 TO 670 MeV/c. Wong, N. S. (Yale Univ., New Haven). Nuovo Cim.; 2A: 353-8(21 Mar 1971).

Angular distributions and polarizations of the two-body final states of the K^-p system were investigated at eight incident K^- momenta from 450 to 670 MeV/c. The measured Legendre coefficients appear to be smooth functions of the energy, an upper limit of 5% for the elasticity of the Σ(1616) was estimated. The result of a multichannel partial-wave analysis is also discussed. (auth)

25335 STUDY OF THE $K^0\Lambda$ AND $K^0\Sigma^0$ FINAL STATES FROM π^-p INTERACTIONS AT 3.9 GeV/c. Abramovich, M.; Blumenfeld, H.; Chaloupka, V.; (and others) (CERN, Geneva). Nucl. Phys.; B27: 477-85(1971).

Differential cross sections and polarizations were measured for the reaction $\pi^-p \rightarrow K^0\Lambda$ and $\pi^-p \rightarrow K^0\Sigma^0$ at 3.9 GeV/c π^- momentum. Comparison of these data with those of the related reactions $K^-n \rightarrow \pi^-\Lambda$ and $K^-p \rightarrow \pi^-\Sigma^+$ (at approximately the same c.m. energy) indicate that simple Regge-pole models involving only K*(890) and K*(1420) exchange are unable to describe all the features of the data. On the other hand, comparison of the $\pi^-p \rightarrow K^0\Sigma^0$ data with that of $\pi^+p \rightarrow K^+\Sigma^+$ shows that the data are consistent with absence of exotic strange-meson exchange. (auth)

25336 MULTI-PERIPHERALISM IN $K^+p \rightarrow \bar{\Lambda}pp$ AND $K^+p \rightarrow \Lambda K^+K^+$ AT 7.3 GeV/c. Mellema, D. J.; Chien, C.-Y.; Slater, W. E.; Stork, D. H.; Ticho, H. K. (Univ. of California, Los Angeles). Nucl. Phys.; B27: 437-63(1971).

Data are presented for the reactions $K^+p \rightarrow \bar{\Lambda}pp$ and $K^+p \rightarrow \Lambda K^+K^+$ at 7.3 GeV/c. A satisfactory parameterization of these processes is obtained using the double-Regge phenomenology. The data are also compared with predictions of a spin-independent, generalized Veneziano model. (auth)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstract 25526.

25337 (COO-1810-7) PROGRESS REPORT [ON PARTICLE PHYSICS, FEBRUARY 1971]. (Michigan State Univ., East Lansing). Contract AT(11-1)-1810. 9p. Dep. NTIS.

Research on field theory using a lattice model, model of fermions using double-valued wavefunctions, the random phase approximation quark model, automatic numerical integration, pion-

nucleus scattering, and the interaction of pions with deuterium is briefly summarized. (J.F.P.)

25338 (IFVE-STF-70-1) SOLUTION OF THE UNITARY CONDITION FOR THE SPIN PARTICLE SCATTERING AMPLITUDE. Savrin, V. I.; Tyurin, N. E.; Khrustalev, O. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1970. 17p. (In Russian). NTIS (U. S. Sales Only).

On the basis of the unitary condition the high-energy elastic scattering amplitude of a scalar particle on $\frac{1}{2}$ spin particle is calculated. The formula for polarization of a spinor particle is presented. (auth)

25339 (IFVE-STF-70-7) HYPOTHESIS ON PERIPHERISM OF THE SCATTERING AND PARTICLE PRODUCTION PROCESSES AT HIGH ENERGIES CORRELATED WITH UNITARITY CONDITION IN S-CHANNEL. Anisovich, V. V.; Khrustalev, O. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1970. 22p. (In Russian). NTIS (U. S. Sales Only).

It is shown that the hypothesis on dominance of peripheral processes at high energies parallel with the unitarity condition in s-channel results in the diffractional picture of the scattering. (auth)

25340 (IFVE-STF-70-43) UNITARY CONDITIONS AND DECREASE OF DIFFERENTIAL CROSS-SECTION OF MULTIPLE PRODUCTION PROCESSES WITH ENERGY INCREASE. Ezhela, V. V.; Logunov, A. A.; Mestvirishvili, M. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1970. 25p. (In Russian). NTIS (U. S. Sales Only).

It is shown, that proceeding from the analytic properties of the inelastic process amplitude and unitary conditions, differential cross sections,of the multiple production processes $d\sigma/d\Omega$ for the fixed $\Theta \neq 0,\pi$ and $\phi \neq 0,\pi$ decrease with energy increase. The upper bound of decrease was found. (auth)

25341 (JINR-E2-5640) SCALAR PARTICLE SCATTERING AMPLITUDE ANALYZED ON THE BASIS OF THE BETHE-SALPETER EQUATION. Kuleshov, S. P.; Matveev, V. A.; Savel'ev, M. V.; Sisakyan, A. N.; Smondyrev, M. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1971. 24p. Dep. NTIS (U. S. Sales Only).

The Bethe–Salpeter equation for the two-particle Green function is solved in the case of the generalized local kernel with the help of the operator method using the modified perturbation theory in exponent. The scalar particle scattering amplitude in the ladder approximation is found and its asymptote in the region of high energies and fixed momentum transfers is investigated. The eikonal representation of the scattering amplitude with the phase corresponding to superposition of the Yukawa quasipotentials is obtained. (auth)

25342 (JINR-P2-5605) QUASIPOTENTIAL EQUATION FOR PARTICLES WITH SPIN 1/2 IN THE CONFIGURATION REPRESENTATION AND THE RELATIVISTIC SPHERICAL SPINORS. Mateev, M. D.; Mir-Kasimov, R. M.; Skachkov, N. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1971. 20p. (In Russian). Dep. NTIS (U. S. Sales Only).

The quasipotential equation describing the interaction of particles with spin $\frac{1}{2}$ and 0 is considered. The matrix elements of the principle series of the Lorentz group unitary representations are used to introduce relativistic spherical spinors and perform a transition to the configurational representation. (auth)

25343 (JINR-P2-5684) COHERENT STATE METHOD AND QUARK MODEL. Bogolyubov, P. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1971. 44p. (In Russian). Dep. NTIS (U. S. Sales Only).

The connection of the coherent state method for the high-energy hadron scattering with the quark models is shown. (auth)

25344 (NP-18748) PHASE-SPACE INTEGRAL WITH TRANSVERSE MOMENTUM CUT-OFF. Research Report No. 16/1970. Sohlo, Seppo (Jyvaskyla Univ. (Finland). Dept. of Physics). Dec 1970. 13p. Dep. NTIS (U. S. Sales Only).

The phase-space integral with a cut-off in transverse momenta is calculated using a four-dimensional Laplace transformation and the saddle-point method. In the transformation there are left two parameters of which the longitudinal one vanishes when the total energy goes to infinity and the transversal one is inversely proportional to the transverse momentum of one secondary particle. The parameters are interpreted as inverse longitudinal and transversal temperatures. Momentum spectra and inelastic cross sections are found in agreement with the main features of experimental data. The energy dependence of one particle momentum spectrum with fixed multiplicity n is similar to the inelastic cross section. After summing over multiplicity, a momentum distribution and total cross section can be obtained, which are constant in energy. The momentum spectrum depends on transverse momentum as $f(p_T)\exp(c/n\, p_T^2)$, where $f(P_T)$ is the transverse cut-off and the constant c is determined by the parameters in $f(P_T)$. (auth) (Finland)

25345 PARITY CONSERVATION IN MANY-PARTICLE REACTIONS AND OBSERVABLE EFFECTS. Dubovikov, M. S. (Moscow Inst. of Physics and Tech.). Yadern. Fiz.; 12: 1298-1301(Dec 1970). (In Russian).

Properties of the amplitude of a many-particle reaction with conserved parity is studied. It is shown what consequences following from these properties may be checked and used experimentally. (auth)

25346 POLARIZATION DENSITY MATRIX FOR PARTICLES WITH ANY SPIN. Kopeliovich, B. Z. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 12: 1286-97(Dec 1970). (In Russian).

A covariant form is obtained for the polarization density matrix for particles with any, integer or half-integer, spin. It is shown that the density matrix for half-integer spins is related in a simple way to the density matrix for integer spin, provided a particular normalization of spin tensors is chosen. Properties of the density matrix that may be useful for applications to various processes are presented. (auth)

25347 PROPERTIES OF THE AMPLITUDES NOT SATISFYING THE CONDITIONS OF THE POMERANCHUK THEOREM. Gribov, V. N.; Kobzarev, I. Yu.; Mur, V. D.; Okun, L. B.; Popov, V. S. Yadern. Fiz.; 12: 1271-85(Dec 1970). (In Russian).

Properties of the scattering amplitudes as functions of the momentum transfer t and of the impact parameter ρ are considered in case when the total cross sections for a particle and the antiparticle are asymptotically ($s \to \infty$) constant and not equal. A detailed consideration is performed for a so called scale-invariant case when the partial amplitudes (up to a common factor) depend only on one variable $x = \rho/\ln s$. (auth)

25348 HYPOTHESIS OF THE PERIPHERAL PROCESSES OF PARTICLE SCATTERING AND PRODUCTION AT HIGH ENERGIES MATCHED TO THE UNITARITY CONDITION IN DIRECT CHANNEL. Anisovich, V. V.; Khrustalev, O. A. Yadern. Fiz.; 12: 1262-70(Dec 1970). (In Russian).

It is shown that the hypothesis on the dominance of peripheral processes at high energies together with the unitarity condition in the direct channel leads to a diffraction picture of the scattering. (auth)

25349 BASIS CONCEPTS OF A STRUCTURE THEORY OF ELEMENTARY PARTICLES. I. Bagge, Erich (Institut fuer Reine und Angewandte Kernphysik, Kiel). Atomkernenergie; 17: 2-14(Feb 1971). (In German).

following the lines of a hydrodynamical theory of liquid droplets a structure theory of elementary particles is developed, which is based on a modified form of Borns statistical interpretation of the quantummechanical wave function. There will be made a difference between the statistical appearence and the disappearence of a—here socalled—"Born event", and a thing produced by interactions of such "Born events", called elementary particle. In the frame of these ideas the electron as the simplest representant of a particle with a rest mass different from zero has a varying internal potential and kinetic energy. Thus this particle may occupy a continuum of possible states of excitation, which are brought to a close relation of the continuum of states in nuclear β-decay. In this first part of our work Schrödinger's wave mechanics is used, while in the following second part Dirac's relativistic theory of the electron will be the basis of our investigations on the internal structure of elementary particles. (auth)

25350 SOLITONS AND ELEMENTARY PARTICLES. Inoue, Hidetoshi; Namiki, Mikio; Ohba, Ichiro (Waseda Univ., Tokyo). Kagaku (Tokyo); 40: 394-401(Aug 1970). (In Japanese).

A solitary wave or soliton is a water surface wave. It propagates with some definite velocity without changing its waveform, just as a free particle. Furthermore, if the one-dimensional collision of two solitons is examined, it is found that the collision proceeds just as the collision of two particles. One-dimensional solitons are represented by a nonlinear wave equation of Korteweg–de Vries. Therefore, it may be presumed that the Korteweg–de Vries equation is capable of describing a free-particle state and a certain elastic scattering state. On the other hand, it is common sense in physics that the elementary particles with interaction should be described by nonlinear wave equations. It

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is generally not ensured that the asymptotic wave of such a nonlinear wave equation becomes always "renormalized" free field. Rather, it is natural to expect the existence of nonlinear waves representing free particles. The behavior of one-dimensional solitons is discussed from this point of view. It is shown that there is the possibility that the occurrence of new solitons is treated by some modification of the KdV equation. In addition to the KdV equation, there are nonlinear wave equations having stable soliton solutions. (Japan)

25351 REMARKS ON THE SPONTANEOUS BREAKDOWN OF CONFORMAL INVARIANCE. Fujii, Y. (Tokyo Univ.). Lett. Nuovo Cim.; 1: 384-7(27 Feb 1971).

A simple sigma model is examined to show that there is no inconsistency in the theory of the spontaneous breakdown of conformal invariance. (J.F.P.)

25352 STATIONARY STATES OF A SPIN-1 PARTICLE IN A CONSTANT MAGNETIC FIELD. Krase, L. D. (Ames Lab., Iowa); Lu, Pao; Good, R. H. Jr. Phys. Rev., D; 3: 1275-9 (15 Mar 1971).

Shay and Good's wave equation is solved for a spin-1 particle with arbitrary magnetic dipole moment. Simultaneous eigenfunctions of the following three operators are used: p_z, the component of $-i\nabla$ in the direction of the field; J_z, the component of $x \times p + s$; and R_0^2, the operator for the square of the distance to the center of the orbit in the projection of the motion perpendicular to the field. Explicit formulas for the allowed energies in terms of the quantum numbers are found. Determination of the wave functions is reduced to a set of linear algebraic equations. (auth)

25353 MOMENTUM SPACE OF THREE FREE PARTICLES. Eriksson, K. E.; Matsson, L. (Inst. of Theoretical Physics, Goeteborg). Phys. Scr.; 2: 135-8(1970).

The motion of three free particles is studied in their center-of-mass frame. In the six-dimensional space of relative momenta the invariant mass is used as a radial variable. Curves perpendicular to surfaces of constant mass ("mass-shells") are labeled by their direction at threshold mass. The relativistic distortion from the nonrelativistic case when the mass shells are ellipsoids is studied. This means a mapping in the radial variable and two of the angular variables (Dalitz plot variables). Since an analytic treatment of the problem seems hardly feasible a numerical study was made. (auth) (Sweden)

25354 RELATIVISTIC SYSTEMS OF INTERACTING PARTICLES. Droz-Vincent, Philippe (Univ., Paris). Phys. Scr.; 2: 129-34(1970).

A multitemporal nonhereditary formulation of relativistic dynamics is given. According to it, a dynamical system of N particles involves some realization of the N-parameter abelian group. The usual concept of flow is replaced by more general tools coming from bitensor calculus. The basic axioms of the theory are expressed in terms of partial differential equations and a nontrivial solution is exhibited. (auth) (Sweden)

25355 RELATIVISTIC KINEMATICS FOR N-PARTICLE SCATTERING STATES. II. QUANTUM MECHANICAL TREATMENT. Eriksson, Karl-Erik (Inst. of Theoretical Physics, Goeteborg). Phys. Scr.; 2: 1-6(1970).

The generalization of grand angular momentum to N-particle states with relativistic energies achieved classically previously is now transcribed into quantum mechanical language. The grand angular momentum are the generators L_{ij} of a $O(3N-3)$-invariance group of the invariant mass operator for N free particles. A radial momentum is defined as well as $O(3N-3)$-invariant operators conjugate to radial momentum or total mass. A construction is made of wave functions spanning irreducible representation spaces of $O(3N-3)$ which are labeled by the eigenvalues of "togetherness" $\Lambda^2 = \frac{1}{2}\sum_{ij} L_{ij}^2$. Finally the sum of all those spaces is shown to be irreducible under a group $O(3N-3, 1)/t$ (where t is "time reversal") which is an invariance group of the mass operator and its canonical conjugate. (auth) (Sweden)

25356 COULOMB AND YUKAWA POTENTIAL GROUPS. Wyler, Armand (Univ., Zurich). Compt. Rend., Ser. A; 272: 186-8(11 Jan 1971). (In French).

The Green functions of symmetric spaces are associated with the Coulomb and Yukawa potentials. This construction leads to an interpretation of the ratio of the masses of particles producing force fields. (France)

25357 HIGH ENERGY PHYSICS INDEX. VOLUME 9, NO. 6, 1971. Frankfurt am Main; Zentralstelle fuer Atomkernenergie-Dokumentation (1971). 74p.

25358 SPACE-TIME DESCRIPTION OF ELEMENTARY PROCESSES, TACHYONS, AND CAUSALITY. Recami, Erasmo (Univ., Catania, Italy). Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur.; 49: 77-91(Jul-Aug 1970). (In Italian).

A possible space-time description of elementary interactions is sketched by using wave packets. This description suggests the assumption of an operator for the chronotopical variables, i.e., also for the observabie time. In particular the position operator is extended for tachyons too. In the previous framework, an elementary formulation of macro-causality may be put forward, and the new anticausality principle—proposed for processes with antiparticle exchanges—may be inserted. The ideal experiment (suggested to test if really in some processes the temporal order of causes and effects can appear reversed) is discussed also on an experimental basis. (auth)

Electromagnetic

Refer also to abstract 25536.

25359 (IFVE-SVM-70-31) APPROXIMATIONS OF PAULI TYPE FOR VECTOR MESON WITH ANOMALOUS MAGNETIC MOMENT IN EXTERNAL FIELD. Kompaniets, V. G. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov, Institut Fiziki Vysokikh Energii). 1970. 9p. (In Russian). NTIS (U. S. Sales Only).

The approximations of Pauli type for equations of Kemmer, Proc, Corben-Schwinger describing vector particles with an anomalous magnetic moment are obtained. The equation of Taub equivalent to the scheme of Fierz-Pauli for the vector particles is considered. (auth)

25360 (JINR-P2-5629) ON THE ep-SCATTERING AMPLITUDE STRUCTURE IN e^2 AND e^4 APPROXIMATIONS. Vanzha, A. P.; Tarasov, A. V. (Joint Inst. for Nuclear Research, Dubna (USSR), Lab. of Nuclear Problems). 1971. 11p. (In Russian). Dep. NTIS (U. S. Sales Only).

The spin structure of the two-photon exchange contribution to the ep elastic scattering amplitude was investigated. Using an equation for such a contribution it is easy to find that only odd products of the Dirac matrices are sandwiched between electron spinors. The direct computing of such matrix elements shows that the amplitude of transitions with changing electron helicity vanish, if the ratio of the electron mass to its energy is neglected. For the one-photon exchange amplitude the same statement is given. Under all general invariance assumptions the full ep scattering amplitude without the electron helicity change contains only three independent spin structures. To determine all two-photon exchange contributions to the ep scattering amplitudes, measurements using the polarized beam and target in e^+p and e^-p scattering are necessary. The expressions for polarization tensors in this case are given. (auth)

25361 (SLAC-Trans-125) QUANTUM FIELD STATE OF THE SYNCHROTRON RADIATION OF A "CLASSICAL" ELECTRON IN A STORAGE RING. Naugol'nii, N. N.; Shenderovich, A. M (Arkademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut). Translated by I. M. R. Jones for Stanford Linear Accelerator Center, Calif., from report KHFTI-70-15. 22p. Dep. NTIS.

The real multiphonon state of the radiation field, its time dependence, polarization, spectrum, angular distribution, and distribution of the number of photons are calculated and compared with the Schott Formula. Information of this kind is of value when synchrotron radiation is used to conduct various types of correlation and interference experiments. (R.W.R.)

25362 ELECTROMAGNETIC MASS DIFFERENCE OF THE ρ MESON. Pietschmann, Herbert (Univ., Vienna). Acta Phys. Austr.; 29: 91-5(1969). (In German).

The Weinberg sum rules as given in the framework of the field algebra model were used to derive a formula for the electromagnetic mass difference of the ρ meson. The formula derived has no strongly divergent integrals. A numerical evaluation gave a value of 1.5 MeV for the electromagnetic mass difference, but no accurate experimental values are available for comparison. (J.S.R.)

25363 QUANTUM ELECTRODYNAMICS AT INFINITE MOMENTUM: SCATTERING FROM AN EXTERNAL FIELD. Bjorken, James D.; Kogut, John B.; Soper, Davison E. (Stanford Univ., Calif.). Phys. Rev., D; 3: 1382-9(15 Mar 1971).

Using a formulation of quantum electrodynamics in the infinite-momentum frame, a theory is developed to describe the scattering of energetic electrons or photons off an external field. A

physical picture emerges which proves to be a realization of Feynman's "parton" ideas. In this picture the incoming electron is composed of bare constituents (the quanta of the Schrödinger fields) which, at high laboratory energies, interact slowly with one another. Each bare constituent is scattered from the external field in a simple way and then the constituents again interact among themselves to form the final state. This formalism is applied to elastic electron and photon scattering, bremsstrahlung and pair production, and deep-inelastic electro-production of lepton pairs, and the results of Cheng and Wu and others are recovered in a simple way. In these applications, perturbation theory is used to construct the wave functions of the constituents in the initial and final states. (auth)

25364 LOW-ENERGY APPROACH TO THE KAON ELECTROMAGNETIC MASS SPLITTING. Yamada, Kazuo (Tokyo Inst. of Tech.). Phys. Rev., D; 3: 1491-9(15 Mar 1971).

The on-shell electromagnetic mass splitting of kaons is studied, on the assumption that it is purely electromagnetic in origin, in a Lagrangian model incorporating vector-meson dominance of the hadronic electromagnetic current. A simple symmetry-breaking term in Lagrangian, which preserves the invariance under the photon gauge transformation, gives the vector-meson mass spectrum and the negative ϕ-ω, mixing angle systematically. The result for δm_K to order α (fine-structure constant) is cutoff dependent. A relatively low cutoff value, around 1 BeV, is required to yield a physically acceptable result. The discrepancy between the theoretical and the experimental values, $\delta m_K^{th} - \delta m_K^{exp} = 5.44 - 6.22$ MeV, is most likely attributable to the high-energy contribution, which was neglected in the present approach. (auth)

25365 ELECTROMAGNETIC INTERACTIONS OF PARTICLES WITH SPIN. I. ELASTIC SCATTERING. Waldenstroem, S.; Olsen, H. Ark. Fys. Seminar Trondheim; No. 2, 1-20(1971).

Cross sections for scattering of two different spin particles are given. The projectile particle with spin s(s = 0, ½, 1, 3/2) is taken to be a point particle without electromagnetic structure, while the effects of the structure of the target particle with spin J(J = 0, ½, 1, 3/2) are described in terms of (2J + 1) phenomenological form factors. (auth)

25366 MULTIPION PRODUCTION IN e^+e^- COLLISIONS. Layssac, J.; Renard, F. M. (Department de Physique Mathematique, Montpellier, France). Lett. Nuovo Cim.; 1: 197-202(30 Jan 1971).

The calculation of $e^+ + e^- \rightarrow n\pi$ below 2 GeV is developed in terms of the quasi-two-body enhancement of the tails of the ρ, ω, and ϕ mesons. The effects of $\pi\omega$, $\pi\phi$, πA_1, πA_2, $\rho\rho$, and $\rho\epsilon$ are included respectively for $e^+ + e^- \rightarrow 4\pi$; and the effects of πB, $\omega\epsilon$, $\phi\epsilon$, are included respectively for $e^+ + e^- \rightarrow 5\pi$. The total cross sections for these interactions are given. (J.F.P.)

25367 ELECTROMAGNETIC INTERACTIONS OF COMPOSITE SYSTEMS. Krajcik, Richard Allen. Cleveland; Case Western Reserve Univ. (1970). 144p. University Microfilms Order No. 71-1714.

Thesis.

It has been shown by others that the Hamiltonian describing the electromagnetic interaction of a loosely bound two-particle system if expressed as the sum of the individual FW electromagnetic interactions of the constituent particles when they have spin will violate the low-energy theorem for Compton scattering and the Drell–Hearn–Gerasimov sum rule, and some progress has been made in formulating interactions which overcome these objections. It is shown that the same problem exists even when the particles are spinless and arises from inadequate treatment of orbital contributions to the magnetic moment of the system. An EM-interaction Hamiltonian is presented for an arbitrary N-particle system with any mass, charge, spin (including orbital angular momentum contributions) and magnetic moment consistent with the properties of the constituent particles, which to order $(\text{mass})^{-2}$ is consistent with the low-energy theorem for Compton scattering and the Drell–Hearn–Gerasimov sum rule and which is related to the sum of the individual FW interaction Hamiltonians by a unitary transformation. (Diss. Abstr. Int., B)

25368 RADIATION OF A RELATIVISTIC ELECTRON IN A COULOMB FIELD. Gargaro, William Wayne. Athens, Ohio; Ohio Univ. (1970). 168p. University Microfilms Order No. 71-4791.

Thesis.

The distortion effects of the nuclear Coulomb field on a relativistic electron which is scattered in the neighborhood of the nucleus are investigated. In particular, one seeks to evaluate those effects when the electron scattering is accompanied by the emission of radiation. It is usual to divide this into two problems. The first is related to a synthetic spectrum of virtual photons by which one may analyze electron-nucleus encounters in which the nucleus makes a transition to a state of higher energy (Coulomb excitation). The second refers to the spectrum of real radiation (bremsstrahlung) which the electron emits freely during collisions with the nucleus. The manner of investigating these problems was to use Dirac–Coulomb wave functions for the electron. This was in contrast to the plane-wave Born-approximation method in which the distortion effects of the nuclear Coulomb field are totally absent from the electron's wave function. By performing a partial-wave analysis of the electron's wave function (with Dirac–Coulomb partial waves) it was found that the two radiation problems are complementary. In one case (bremsstrahlung) the real radiation escapes the interaction region altogether and is detected at infinity. In the other (Coulomb excitation), the virtual radiation is detected at the origin by the nucleus itself. Thus, one could reduce the calculation of the interaction matrix elements for the two processes to a single integral form common to both. The evaluation of the resulting radial integral required the development of an analytic continuation formula for the Appell F_2 function. Subsequently, the first few multipole contributions (electric dipole, magnetic dipole, etc.) to the cross sections for the two scattering phenomena were calculated for various incident electron energies and target (point) nuclei. The results of the calculations show that for incident electron energies on the order of 10 MeV the distortion effects of the nuclear Coulomb field may be quite large. This is clearly the case when the target nuclei have atomic numbers above about thirty and the electron loses more than 20 to 30 percent of its initial energy during the collision. In the point-nucleus limit large deviations from plane-wave Born-approximation (PWBA) results are found, especially near the limit in which the electron loses nearly all of its kinetic energy. Further, for magnetic dipole transitions, the spectrum is seen to be increased by an overall factor of about twenty relative to the same PWBA spectrum (for uranium). Such large discrepancies will clearly affect the analysis of experimental data. It is found that many multipole contributions must be calculated to describe the bremsstrahlung cross section, especially when the scattering angle of the electron is less than about 60°. For large scattering angles (greater than about 150°) the contributions from the higher multipoles decrease very rapidly and, hence, only a few are needed. The large-angle scattering region is also the one in which Coulomb-distortion effects are most clearly discernible. (Diss. Abstr. Int., B)

25369 RELATIVISTIC EXTENSION OF THE ELECTROMAGNETIC CURRENT FOR COMPOSITE SYSTEMS. Close, F. E. (Stanford Univ., Calif.); Osborn, H. Phys. Lett.; 34B: 400-4 (15 Mar 1971).

A general method is formulated for evaluating relativistic and binding energy corrections to matrix elements of the electromagnetic current for multiparticle composite systems. Application is made to the calculation of the g-factor for bound electrons and compared with recent experiments. (auth)

25370 Σ^0/Λ^0 RATIO IN K^+ PHOTOPRODUCTION AND SU(3). Michael, C.; Odorico, R. (CERN, Geneva). Phys. Lett.; 34B: 422-4(15 Mar 1971).

A simple analysis of $K^* - K^{**}$ exchange in K^+ photoproduction provides an explanation of the Σ^0/Λ^0 ratio in terms of the known nonstrange vector-tensor meson couplings. (auth)

25371 CORRESPONDENCE IDENTITIES. V. THE ZERO-ENERGY COULOMB PROBLEM. Norcliffe, A. (Univ. of Stirling, Scotland). J. Phys., B (London); 4: 143-52(Feb 1971).

The classical and quantal problem of a charged particle moving in an attractive Coulomb potential with total energy zero is considered. A complete correspondence identity is obtained by expressing the kernel of the quantum-mechanical spectral operator $I_E = \delta(E - H)$ exactly in terms of the classical action function in momentum representation. Use is made of the dynamical symmetry properties exhibited by both the classical and quantal problems, and a path-integral method of evaluating the spectral operator kernel is also presented. (auth) (UK)

25372 RELATIVISTIC CALCULATION OF THE REACTION $\gamma d \rightarrow d\pi^0$. I. THE SCATTERING AMPLITUDE FOR SCALAR PARTICLES DUE TO GRAPHS WITH INFINITY-TYPE SINGULARITIES. Ambrosius, Guenter (Univ., Bonn). Nucl. Phys.; A163: 265-76(1971).

The scattering amplitude for the reaction $\gamma d \rightarrow d\pi^0$ is calculated relativistically starting from the Feynman rules. The graphs which are included in the calculation are selected by the criterion that the corresponding amplitude, analytically continued in s and t, becomes infinite at a point near to the physical region. All possible graphs of this type are calculated for scalar particles up to a small background due to some far-away cuts from singularities, which are not of the infinity-type. (auth)

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25373 SEPARABLE POTENTIALS AND COULOMB INTERACTIONS. Husain, D. (Dacca Univ., Pakistan). J. Phys., A (London); 4: 214-16(Mar 1971).

The scattering of two charged particles by a separable nonlocal potential and a repulsive Coulomb potential was studied. Exact expressions were derived for the scattering amplitude and an equivalent local potential. (auth) (UK)

25374 FINAL STATE INTERACTION IN HIGH ENERGY e^+e^- ANNIHILATION INTO HADRONS. Shuryak, E. V. (Inst. of Nuclear Physics, Novosibirsk, USSR). Phys. Lett.; 34B: 509-11(29 Mar 1971).

The interaction of secondaries is very important for all multiple production processes. For high energy one photon e^+e^- annihilation into hadrons the multiplicity, composition and energy distribution of the secondaries are obtained in a way similar to Landau theory. (auth)

25375 α^2 RADIATIVE LAMB SHIFT. Peterman, A. (CERN, Geneva). Phys. Lett.; 34B: 507-8(29 Mar 1971).

The fourth order crossed electromagnetic vertex is examined. A very high precision numerical evaluation of the slope at $q^2 = 0$ is performed in the Feynman gauge. This completes the fourth order radiative shift which contributes in H and D by (0.427 ± 0.002) MHz. An uncertainty of this order can be neglected in the scattering approximation and is of no significance for physical applications. (auth)

25376 TOTAL PHOTON–PROTON CROSS SECTION FOR HADRON PRODUCTION. Armstrong, T. A. (Univ. of Glasgow); Hogg, W. R.; Lewis, G. M.; (and others). Phys. Lett.; 34B: 535-8(29 Mar 1971).

The total hadronic cross section, σ_T was measured for tagged γ-rays, using electron beams in the GeV range, and narrow energy bins. Preliminary data are given covering the γ-energy region 275 MeV–1850 MeV, where interesting structure characteristics are observed. (auth)

25377 ELECTROPRODUCTION OF $\Delta(1236)$ IN THE π^0 CHANNEL AT A FOUR MOMENTUM TRANSFER OF 25 fm^{-2}. Albrecht, W. (Deutsches Elektronen-Synchrotron, Hamburg); Brasse, F. W.; Dorner, H.; (and others). Nucl. Phys.; B27: 615-20(1971).

The electroproduction of the $\Delta(1236)$ was investigated by measuring angular distributions of the outgoing proton. Coefficients of these angular distributions for a wide mass range around the resonance are given at a momentum transfer of 25 fm^{-2}. Also given are the resonant multipoles in a small range around the resonance. The γNN^* form factor obtained from our work at 15 and 25 fm^{-2} is compared with other results. (auth)

25378 JET MODEL FOR e^+e^- ANNIHILATION INTO PIONS. Calucci, G. (Univ., Trieste, Italy); Drago, F.; Jengo, R. Nuovo Cim.; 2A: 407-18(21 Mar 1971).

A picture of the annihilation is considered in which the intermediate virtual photon decays into two virtual pions, which in turn give rise to two jets of physical pions. An explicit model is constructed for the mechanism of particle production in the jet, and predictions are obtained for the total cross section of the annihilation into pions, for the partial cross sections in the various configurations of charge and for the multiplicity. (auth)

25379 HIGHLY VIRTUAL PHOTONS AND LIGHT-CONE SINGULARITIES OF ELECTROMAGNETIC CURRENT COMMUTATOR. Georgelin, Y. (Institut de Physique Nucleaire, Orsay, France); Stern, J.; Jersak, J. Nucl. Phys.; B27: 493-524(1971).

It is proposed that the light-cone behavior, established previously for different components of the forward proton matrix element of the electromagnetic current commutator from the deep inelastic ep scattering experiments, reflects a universal property of the current commutator itself and is reproduced in various other matrix elements. Experimental consequences of this conjecture, concerning the asymptotic behavior of corresponding amplitudes for highly-virtual photons, are discussed. The following processes are considered: (i) deep inelastic scattering of polarized leptons on polarized protons, (ii) high-energy annihilations $e^+e^- \to \pi^0\gamma$ and $e^+e^- \to \pi^0\rho^0$, (iii) photoproduction of high invariant lepton pairs and, (iv) electroproduction of high-energy ρ^0 mesons on a spin-zero target. (auth)

25380 MANIFEST DYALITY INVARIANCE IN ELECTRODYNAMICS AND THE CABIBBO–FERRARI THEORY OF MAGNETIC MONOPOLES. Han, M. Y.; Biedenharn, L. C. (Duke Univ., Durham, N. C.). Nuovo Cim.; 2A: 544-56(21 Mar 1971).

One of the intrinsic symmetry properties of the Maxwell–Lorentz theory of electrodynamics is the invariance of the theory under "dyality" transformation, that is, a dual transformation on fields and sources simultaneously. A manifestly dyality-invariant formulation of electrodynamics is given. This is done by expressing the electromagnetic-field tensors in terms of an antisymmetric tensor of rank two, called a Hertz tensor, consisting of electric and magnetic Hertz vector potentials. An equation is derived which relates the electromagnetic fields when sources consist of electric charges only, magnetic charges only, and both. The present formalism provides a natural physical basis for the Cabibbo–Ferrari theory in which two four-vector potentials and a mixed gauge transformation between them are introduced. (auth)

25381 REMARKS ON $\pi^\pm$ ^{4}He SCATTERING AND THE ELECTROMAGNETIC RADIUS OF THE CHARGED π-MESONS. Oades, G. C.; Rasche, G.; Zimmermann, H. (Univ., Zurich). Nuovo Cim.; 2A: 438-43(21 Mar 1971).

The method of evaluating the electromagnetic radius r_π of the charged π-mesons from $\pi^\pm$ ^{4}He scattering measurements is improved compared to a former calculation. It is shown that no new results arise; the present experimental data are too inaccurate to give a reasonable estimate for r_π. (auth)

25382 NEUTRINO-PAIR PRODUCTION BY PHOTONS. Landovitz, L. F.; Schreiber, W. M. (Yeshiva Univ., New York). Nuovo Cim.; 2A: 359-83(21 Mar 1971).

The neutrino-pair production process $\gamma + \gamma \to \nu + \bar{\nu}$ is considered. Using an intermediate-boson theory, the cross section for ν_e, $\bar{\nu}_e$ and for ν_μ, $\bar{\nu}_\mu$ production is evaluated to lowest order by dispersion relation techniques. The result is found to be essentially the same whether one uses the Haller, Landovitz, and Goldberg intermediate-boson theory or the Lee and Yang intermediate-boson theory. The lowest-order nonvanishing matrix element is of the order ω^3, and hence the lowest-order cross-section is of the order ω^6. For electron-type neutrinos and a boson mass of 2 GeV, one obtains $\sigma = (4.8)(10^{-46})(\omega/M_p)^6$ cm^2 where M_p is the proton mass. The corresponding black-body neutrino luminosity is $L = (2.4)(10^{-7}) \cdot (T/10^9)^{13}$ erg/cm^3 s. For muon-type neutrinos, both of the above formulas are reduced by a factor of ten. (auth)

Weak

Refer also to abstracts 25515 and 25519.

25383 (IFVE-STF-70-14) DETERMINATION OF THE $\Delta T = 7/2$ TRANSITION IN THE $K \to 3\pi$ DECAY. Dakhno, L. G.; Likhoded, A. K. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1970. (In Russian). NTIS (U.S. Sales Only).

A method is proposed to determine experimentally the $\Delta T = 7/2$ transition in the $K \to 3\pi$ decay. (auth)

25384 (NYO-1932(2)-182) REMARKS ON THE $|\Delta\vec{I}| = \frac{1}{2}$ RULE IN NON-LEPTONIC WEAK DECAYS AND THE USE OF THE PHENOMENOLOGICAL LAGRANGIAN. Lee, T. D. (Columbia Univ., New York). [1970]. 62p. Dep. NTIS.

It is shown that the validity of the usual "soft-pion" limit and the existence of a $|\Delta\vec{I}| = \frac{1}{2}$ rule for nonleptonic weak interactions are two independent assumptions. The alleged derivation of the $|\Delta\vec{I}| = \frac{1}{2}$ rule for nonleptonic K decays by using the "soft-pion" limit is, therefore, incorrect. As examples, several different phenomenological Lagrangian models for nonleptonic K decays are examined which illustrate the logical independence of these two assumptions. A speculative possibility concerning the origin of the $|\Delta\vec{I}| = \frac{1}{2}$ rule is analyzed. (auth)

25385 LOW-ENERGY ADLER–DOTHAN THEOREM AND DECAYS $\pi(K) \to \pi e\nu\gamma$, $\pi(K) \to e^+e^-e\nu$. Musakhanov, M. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 12: 1243-8(Dec 1970). (In Russian).

Using the gauge invariance, the CVC and PCAC hypothesis, amplitudes are obtained for the processes $\pi(K) \to \pi e\nu\gamma$ and $\pi(K) \to e^+e^-e\nu$, accurate up to terms $\sim(kq)$; with k, the photon (or the electron–positron pair) momentum, and q, the total lepton neutrino momentum. In case of the decay $\pi \to e^+e^-e\nu$, a possibility is indicated to determine the axial form factor a without any ambiguity, comparing the data with those on the $\pi \to e\nu\gamma$ decay. (auth)

25386 MODERN THEORY OF STAR EVOLUTION AND EXPERIMENTS OF F.REINES ON $\bar{\nu}$ SCATTERING DETECTION. Domogatskii, G. V.; Nadezhin, D. K. (Moscow Inst. of Physics). Yadern. Fiz.; 12: 1233-42(Dec 1970). (In Russian).

Restrictions on the possible value of the magnetic moment of neutrino are obtained based on the main concepts of the modern theory of the structure and evolution of stars. A question is also discussed on the limiting allowed value of the weak (νe) (νe) interaction constant. The reliability of various estimates based on astrophysical considerations is analyzed in detail. (auth)

25387 MUONS IN THE SUPER-HIGH ENERGY REGION. ON KEUFFEL'S OBSERVATION OF DIRECT PRODUCTION OF MUON MUONS. Kitamura, Takashi (Osaka City Univ.); Kobayakawa, Keizo Kagaku (Tokyo); 40: 301-10(Jun 1970). (In Japanese).

Recently, the result of an observation of the angular distribution of super-high energetic muons under the ground was given. The result differs significantly from theoretical expectation that the muons are produced through the decay of π and K mesons. A new process (X-process) was suggested to explain the observation. Research groups have since made several attempts, both theoretically and experimentally, to ascertain and criticize the result. These attempts are reviewed. Another observation also deviates from the π-μ decay. The deviation is, however, opposite to that in the former result. Several attempts were made to interpret the discrepancy. It was suggested that, when errors are carefully taken into account, both results are well within the usual theoretical calculation. (Japan)

25388 K_1^0-K_2^0 MASS DIFFERENCE IN THE VENEZIANO MODEL. Dutt, R. (Israel Inst. of Tech., Haifa); Chaudhuri, R. N.; Taank, J. K. Lett. Nuovo Cim.; 1: 388-90(27 Feb 1971).

It is pointed out that the correct sign and magnitude of the $K_1^0 - K_2^0$ mass difference can be reproduced by the strict use of the Veneziano model, although it gives a few incorrect relations. (J.F.P.)

25389 PHOTON AS A COMPOSITE STATE OF A NEUTRINO-ANTINEUTRINO PAIR. Bandyopadhyay, Pratul; Chaudhuri, Probhas Ray (Indian Statistical Inst., Calcutta). Phys. Rev., D; 3: 1378-81(15 Mar 1971).

The possibility that the photon may be a composite state of a neutrino-antineutrino pair has been examined from field-theoretic considerations on the basis of the photon-neutrino weak-coupling theory. It is shown that the difficulties which generally crop up in quantum electrodynamics to describe a photon as a composite state of an electron-positron pair using the $Z_3 = 0$ condition are avoided in neutrino dynamics (photon-neutrino weak interaction). In view of this, it is concluded that the photon may be taken as a composite state of a neutrino-antineutrino pair when the composite character is described by the vanishing of the wave-function renormalization constant and the nonvanishing of a certain composite coupling constant. (auth)

25390 PRODUCTION OF WEAK SCALAR BOSONS IN LEPTON ANTILEPTON COLLIDING BEAMS. Ellis, J. L.; Ellis, D. G. (Univ. of Toledo). Phys. Lett.; 34B: 419-21(15 Mar 1971).

Weak interaction cross sections for high energy lepton–antilepton collisions are calculated in the scalar boson theory. The cross sections obtained are several orders of magnitude larger than those predicted recently for production of intermediate vector bosons. (auth)

25391 CALCULATION OF THE $K^+ \to \pi^+\pi^0$ DECAY. Preparata, G. (Univ., Rome). Phys. Lett.; 34B: 412-14(15 Mar 1971).

A calculation of the $K^+ \to \pi^+\pi^0$ decay process is carried out in the current–current picture of weak interactions. (auth)

25392 CONSISTENCY OF EXTRAPOLATION FROM SOFT-π AND -K LIMITS IN K_{l3} DECAY. Nasrallah, N. F. (Lebanese Univ., Beirut); Schilcher, K. Nuovo Cim.; 2A: 401-6(21 Mar 1971).

The Callan–Treiman relations for the scalar form factor in K_{l3} decay differ depending on which meson, the K or the π, is taken to be "soft." It is shown that the results are consistent provided there exists a K–π final-state 0^+ enhancement at 1080 MeV (the κ-meson). (auth)

25393 PSEUDOSCALAR FORM FACTOR IN WEAK LEPTONIC NUCLEAR PROCESSES. Kim, C. W.; Mintz, S. L. (Johns Hopkins Univ., Baltimore). Nucl. Phys.; B27: 621-32(1971).

The induced pseudoscalar form factor $F_P(q^2; i \to f)$ in weak leptonic nuclear processes was calculated (i) using the impulse approximation and (ii) applying the PCAC hypothesis directly to nuclei. Differences between the two methods are discussed in detail. Comparison of the two results with the experimental partial muon-capture rates of ^{3}He, ^{6}Li, and ^{12}C suggests that the impulse approximation estimate appears to be inconsistent with experiment in the case of ^{6}Li. (auth)

25394 DIVERGENCE IN RADIATIVE CORRECTIONS TO NEUTRINO–ELECTRON SCATTERING AND NEUTRAL CURRENTS. Kerimov, B. K.; Tsvetkov, V. P. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 11: 715-17(Nov-Dec 1970). (In Russian).

An accurate value for α-order radiation correction of $\nu_e e \to \nu_e e$ scattering previously could not be achieved within the limits of the up-to-date theory because one of the integrals in the final equation was in logarithmic disagreement and demanded a cut-off parameter Λ. With the $\Lambda \to \infty$ the radiation correction became infinite. An attempt was made of showing a possibility of α-order radiation correction to the $\nu_e e$-scattering in which all the expressions were in agreement. In such a case the weak Lagrangian interaction in addition to the product of charged currents $(\bar{e}\nu_e)(\bar{\nu}_e e)$ was supplied with the products of neutral baryon and lepton currents: $L_{ef}^{\rho} = (G/\sqrt{2})(\bar{\rho}\gamma_j(1+\gamma_5)\rho)(\bar{\nu}_e\gamma_f(1+\gamma_5)\nu_e)$. The above expression resulted in a direct scattering of the $\nu_e e$ neutrino on the proton $\nu_e + \rho \to \nu_e' + \rho'$. Data obtained showed that the introduction of the neutral baryon and lepton currents into the weak interaction Lagrangian resulted in an effective cutoff of diverging integrals of the α order radiation correction to the neutrino–electron scattering with cut-off parameters $\Lambda = m\rho$. (R.V.J.)

Strong (General)

Refer also to abstract 25527.

25395 (RLO-1388-601) REGGE BEHAVIOR IN INCLUSIVE EXPERIMENTS. Peccei, R. D.; Pignotti, A. (Washington Univ., Seattle. Dept. of Physics). Feb 1971. 13p. Dep. NTIS.

The Regge prediction for the behavior of inclusive cross sections near the kinematic boundary is discussed and compared with a recent conjecture. Some existing experimental data are analyzed and, in particular, no evidence is found yet for diffraction dissociation into high masses (three Pomeron coupling). (auth)

25396 SCALE INVARIANCE, GOLDSTONE BOSONS, AND THE f' TRAJECTORY. Chiu, C. B. (California Inst. of Tech., Pasadena. Argonne National Lab., Ill.); Fujii, Y.; Wada, W. W. Lett. Nuovo Cim.; 1: 110-15(16 Jan 1971).

The possibility is considered that the actual world of hadrons is close to the scaler-invariance limit. To give an approximate description of the hadron mass spectra at least two Goldstone bosons are required, which must be nearly massless for scale invariance to hold. It is proposed that the nonsense state on the f' trajectory at $\alpha_{f'} = 0$ should be identified as the Goldstone boson for the mass splitting within each SU(3) multiplet. (J.F.P.)

25397 DIRECT-CHANNEL REGGEIZATION OF STRONG-INTERACTION SCATTERING AMPLITUDES. I. Creekmore, Stephen P. (California Inst. of Tech., Pasadena). Phys. Rev., D; 3: 1400-7(15 Mar 1971).

The construction of Reggeized strong-interaction amplitudes is discussed in a series of three papers. In this paper (Paper I), the amplitude is expanded in a partial-wave series with the individual partial-wave amplitudes represented as products over direct-channel Regge-pole contributions. Unitarity bounds automatically hold for direct-channel processes. Such representations are shown to account for the essential features of both elastic and inelastic scattering, in terms of the Regge trajectories on several Riemann sheets. It is shown that difficulties usually associated with rising trajectories are naturally avoided in this formulation. (auth)

25398 DIRECT-CHANNEL REGGEIZATION OF STRONG-INTERACTION SCATTERING AMPLITUDES. II. Creekmore, Stephen P. (California Inst. of Tech, Pasadena). Phys. Rev., D; 3: 1407-18(15 Mar 1971).

Direct-channel Reggeized strong-interaction scattering amplitudes are defined in terms of a set of direct-channel phase shifts and elasticity factors. These quantities are functions of the positions of direct-channel Regge poles and certain convergence factors, which are related to crossed-channel behavior. Two mathematical techniques are discussed which can be used to continue these partial-wave expansions outside their ordinary region of convergence. Unphysical values of angular momentum are not used in the continuation methods. The numerical method requires the partial-wave amplitudes specified at positive-integer values of l only. The analytic method can be used to calculate precisely the discontinuity across the crossed-channel cut, and thus would be valuable in further theoretical work using these representations. Applications of these methods are discussed, with reference to two earlier phase-shift Reggeization schemes. (auth)

25399 DIRECT-CHANNEL REGGEIZATION OF STRONG-INTERACTION SCATTERING AMPLITUDES. III. Creekmore, Stephen P. (California Inst. of Tech., Pasadena). Phys. Rev., D; 3: 1419-28(15 Mar 1971).

A class of representations is discussed which describe the direct-channel S-matrix partial-wave projection in terms of direct-channel Regge poles $\{\alpha_a^I(s)\}$, Regge zeros $\{\alpha_b^{II}(s)\}$, and a convergence factor $\phi(\lambda)$, as follows:

$$\ln S_l = [\Sigma_n \int_{\alpha_n^I}^{\alpha_n^{II}} \phi(\lambda)(\lambda - l)^{-1}\, d\lambda]/\phi(l).$$

Mathematical methods, introduced in Paper II of this series, are expanded here to take advantage of the particular representation of the function $\phi(\lambda)$ which is shown to be required by proper behavior of the amplitude near the closest cross-channel singularities. The ways in which more detailed crossing-symmetry requirements specify $\phi(\lambda)$, given an approximate set of direct-channel poles and zeros, are discussed. It is shown that the representation for $\phi(\lambda)$ produces large families of infinitely rising crossed-channel trajectories in a simple way. It is shown that these amplitudes automatically have the proper direct-channel phase-shift threshold behavior, provided that the functions $\{\alpha_n^I(s), \alpha_n^{II}(s)\}$ have the threshold behavior usually required. In addition, it is shown that this trajectory threshold behavior follows, for our amplitudes, from imposition of proper behavior in the neighborhood of the nearest crossed-channel singularity; i.e., no recourse to results derived outside the context of this class of representations is necessary. A simple bootstrap calculation is performed, for the purposes of illustration. It is shown that the zeros of the function $\phi(\lambda)$ are closely related to the background integral in the conventional Sommerfeld–Watson summation scheme. (auth)

25400 SUPERCONVERGENCE SUM RULES AND EXCHANGE DEGENERACY IN CROSS-DUALITY MODEL. Taha, M. O. (International Centre for Theoretical Physics, Miramare, Italy). Phys. Rev., D; 3: 1461-7(15 Mar 1971).

Superconvergence conditions and finite-energy sum rules in the cross-duality model are verified and discussed. Exotic channels give exchange degeneracies among branch-point trajectories, which induce degeneracies on their generating pole trajectories. The Pomeranchuk singularity is also briefly considered. (auth)

25401 COMMENTS ON THE CONNECTION BETWEEN THE VENEZIANO MODEL AND MASS QUANTIZATION CONDITIONS. Cooper, Fred (Cornell Univ., Ithaca, N. Y.). Phys. Rev., D; 3: 1517-18(15 Mar 1971).

It is shown that Veneziano-type models can be constructed for scattering processes containing zero-mass pions in which the requirements of satisfying soft-pion theorems lead to no constraints on the Regge parameters. This casts doubt on the arguments of Ademollo, Veneziano, and Weinberg, who obtain mass quantization conditions from those requirements. (auth)

25402 SOME SPECULATIONS IN THE FRAMEWORK OF REGGE POLES. Ratti, Sergio P. Rend. Semin. Mat. Fis. Milano; 39: 85-95(1969).

From Symposium in Honor of Giuseppe Occhialini on the 20th Anniversary of His Return to Italy, Milan, Italy. See CONF-681083.

The Regge pole theory for strong interactions is discussed. A numerical game is used as a crude check to verify the theory. (J.F.P.)

25403 UNIVERSAL EXCHANGE DEGENERACY AND A NEW METHOD FOR ANALYSIS OF TOTAL CROSS SECTIONS. Lipkin, Harry J.; Rabl, Veronika (Weizmann Inst. of Science, Rehovot, Israel). Nucl. Phys.; B27: 464-76(1971).

Striking regularities are revealed by plotting experimental total cross sections against one another, rather than each individually against energy. These plots are fit by straight lines, as predicted by arguments based on duality and absence of exotics, but extend beyond the energy range where simple Regge-pole descriptions are valid. This suggests universal exchange degeneracy not only for Regge poles but also for cuts, bruises and other injuries commonly inflicted on the simple Regge description to fit the energy dependence. Slopes of plots give ratios of hadron-trajectory couplings which are compared with symmetry and universality predictions. The contrast between the flat K^+N and decreasing pp cross sections is exhibited by these plots, and indicates a difficulty in the conventional exchange-degeneracy description. (auth)

25404 MULTIPERIPHERAL DYNAMICS AND INCLUSIVE EXPERIMENTS. Silverman, D.; Tan, C.-I. (Princeton Univ., N. J.). Nuovo Cim.; 2A: 489-513(21 Mar 1971).

The relationship between multiperipheral dynamics and inclusive experiments at high energy is developed. The general features of the single-particle distribution spectrum are exhibited for multiperipheral models with exponential damping in the momentum transfers. By working with a specific multi-Regge model the phenomena of pionization and of scaling in longitudinal momentum for small momentum transfers is further demonstrated. Examples of distribution spectra are given for specific and physically important values of Regge parameters. The predictions can serve as a test for a realistic model for the integral-equation approach to multiperipheral dynamics, and can provide a sensible form for parametrizing experimental data. (auth)

25405 GENERAL APPROACH TO DUAL MULTILOOP DIAGRAMS. Alessandrini, V. (CERN, Geneva). Nuovo Cim.; 2A: 321-52(21 Mar 1971).

The general solution of the Fairlie–Nielsen analog model for dual multiparticle theory is discussed. By using the theory of functionals on Riemann surfaces, it is shown that all the relevant Green functions for orientable and nonorientable multiloop diagrams can be obtained in terms of Burnside automorphic functions. As an example, the one-loop orientable and nonorientable diagrams are considered in detail from this point of view. A general discussion of N-loop orientable and nonorientable diagrams in the operator formalism is also given. (auth)

Strong (Baryon No. = 0)

Refer also to abstract 25514.

25406 (ITF–70-85-E) ABOUT A SPACE-TIME OPERATOR IN COLLISION DESCRIPTIONS. Olkhovskii, V. S.; Recami, E. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1970. 14p. Dep. NTIS (U. S. Sales Only).

Some previous works about space–time description of collision processes are partially concluded. Namely, a (nonnormal) chronotopical coordinate operator, previously suggested, is considered, and it is shown how its Hermitian parts work in the relativistic wave-packet formalism. The spin-zero-particle case is analyzed, and the canonical correspondence between the "tetraflux" and the "chronotopical" operators, for free Klein-Gordon particles, is underlined. The operator introduced for time is particularly emphasized. As an application the time-evolution of potential scattering is evaluated comparing the U-matrix and the S-matrix treatments. Besides the possible meaning of the anti-Hermitian parts of the operators above considered is investigated, in the spirit of a discrete space–time description. (auth)

25407 (JINR–E2-5656) ANALYSIS OF THE DOUBLET STRUCTURE OF THE Q-RESONANCE BY FOURIER ALGORITHM. Dubovik, V. M.; Markovski, B. L.; Soroko, L. M.; Strizh, T. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1971. 10p. Dep. NTIS (U. S. Sales Only).

The experimental data on Q (1240 to 1400) are reanalyzed by the method of the Fourier-algorithm. It is shown that the Q-peak results from an incoherent superposition of two components, the distance between their centers being $\Delta = (137.0 \pm 8)$ MeV. Attempts to extract the Breit–Wigner widths of the doublet components are made. (auth)

25408 (NYO–2171-326) FUNCTIONAL DIFFERENTIAL EQUATIONS DETERMINING REPRESENTATIONS OF LOCAL CURRENT ALGEBRAS. Goldin, G. A.; Sharp, D. H. (Pennsylvania Univ., Philadelphia. Dept. of Physics). [1970]. Contract AT(30-1)-2171. 25p. Dep. NTIS.

The problem of finding an irreducible representation of a local current algebra is understood as the problem of solving a functional differential equation. The solution to this equation and how a knowledge of this solution enables one to compute all quantities of physical interest in the theory are considered. The analysis was carried out for a system of noninteracting bosons. (J.F.P.)

25409 COUPLINGS OF S* TO THE ENERGY–MOMENTUM TENSOR. Genz, H.; Steiner, F. (Univ., Karlsruhe, Ger.). Lett. Nuovo Cim.; 1: 358-60(27 Feb 1971).

The coupling $g^* T_\mu^\mu S^*$ is considered. A relation between G_{S^*NN} and $G_{S^*\pi\pi}$ is obtained, and the ratio $\lambda \equiv \Gamma_{S^*K\bar{K}}/\Gamma_{S^*\pi\pi}$ is found to be 0.9. (J.F.P.)

25410 DIRECT-CHANNEL HELICITY CONSERVATION FOR INELASTIC REACTIONS AND THE SPIN–PARITY RULE. Thews, R. L. (Univ. of Arizona, Tucson). Lett. Nuovo Cim.; 1: 366-70 (27 Feb 1971).

Quasi-two-body interactions $A + T \to B + T$ are studied. It is shown that a property of these reactions relating the parity change to the change in angular momentum follows from direct-channel helicity conservation if A and B are mesons and one of them is spinless. For baryons and photon–meson pairs such a rule does not follow. (J.F.P.)

25411 HILBERT–SCHMIDT EXPANSION AND THE SOLUTION OF FADDEEV'S EQUATIONS WITH THE POTENTIAL OF RECTANGULAR FORM. Kharchenko, V. F.; Storozhenko, S. A.

(Inst. of Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 15: 1846-55(Nov 1970). (In Russian).

The problem of the motion of three identical spinless particles and the problem of three nucleons are considered in the case when the two-particle interaction is characterized by the local potential of rectangular form. Using the separable Hilbert—Schmidt expansion, the problem is reduced to the solution of a system of one-dimensional integral equations. Binding energies and the scattering length of three identical spinless particles as well as the triton binding energy and the neutron-deuteron scattering lengths are calculated. The contribution of the components of the two-particle interaction with the non-zero values of orbital momentum to binding energies and scattering lengths of three-particle systems is estimated. (auth)

25412 OFF-MASS-SHELL EXTRAPOLATION FOR η-MESON SCATTERING. Fuchs, Norman H. (Purdue Univ., Lafayette, Ind.). Contract AT(11-1)-1428. Phys. Rev., D; 3: 1514-16 (15 Mar 1971).

Assuming that the η-meson interpolating field is approximately given near zero four-momentum squared by the divergence of the eighth axial-vector current A_μ^8, matrix elements describing η scattering on various targets are continued off the mass shell. The amplitudes are of the Veneziano form on the mass shell. Results include $\alpha_1(m_\eta^2) = 1/2$, where $\alpha_1(t)$ is the degenerate φ, f' Regge trajectory function, quantization of masses analogous to that obtained using similar assumptions for π scattering, equality of the D/F ratio of tensor trajectory coupling to baryons, and the D/F ratio of the octet mass-splitting spurion coupling to baryons. (auth)

25413 PADE APPROXIMANT CALCULATION OF p-WAVE π-π SCATTERING WITH A σ MODEL LAGRANGIAN. Elias, D. K. (Univ. of Toronto). Can. J. Phys.; 49: 360-6(1 Feb 1971).

A π-π interaction via a scalar I = 0, σ exchange is considered. The contribution of the t and u channel exchanges of the σ to the p-wave, I = 1 amplitude is calculated using Padé approximants. A p-wave resonance, interpreted as the ρ meson, the width of which depends on the mass of the input σ meson, is found; for a certain range of values of the σ mass the ρ width compares not unfavorably with similar calculations using a $\lambda\phi^4$ interaction. However, for the range of masses considered the width is considerably smaller than the experimental value. The I = 0, d-wave channel is also considered and a resonance, interpreted as the $f^0(1260)$, is found. (auth) (Canada)

25414 ROTATION INVARIANCE AND THE STRUCTURE OF THE S-WAVE $\pi\pi$ CROSS SECTION. Gutay, L. J. (Purdue Univ., Lafayette, Ind.); Scharenguivel, J. H.; Fuchs, N.; (and others). Nucl. Phys.; B27: 486-92(1971).

The $\pi\pi$ effective mass distribution for the isotropic term in a coordinate system was determined where the tensorial background is minimized. A new structure at 0.66 GeV was observed. (auth)

25415 MESON FIELD POTENTIAL IN FUNDAMENTAL THEORY. Klotz, A. H. (Univ. of Sydney). J. Proc. Roy. Soc. N. S. W.; 102: 201(1969).

It is shown that Yukawa's potential of a meson field can be generated within Eddington's fundamental theory. (auth)

Strong (Baryon No. = 1)

Refer also to abstracts 25331, 25332, 25335, and 25414.

25416 (IFVE-STF-70-3) SOME CONSEQUENCES OF THE CONSTANT BEHAVIOR OF THE TOTAL CROSS-SECTION ABOVE 30 GeV. Aznauryan, I. G.; Solov'ev, L. D. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1970. 25p. (In Russian). NTIS (U. S. Sales Only).

The Serpukhov data on total cross sections up to 65 GeV suggest that the differences of the total cross sections $\delta(\pi^-) - \delta(\pi^+)$ and $\delta(K^-) - \delta(K^+)$ may be independent of energy above 25 to 30 GeV. Some consequences of this suggestion are considered. In particular, the differential cross section for pion-nucleon charge-exchange scattering and the K-meson regeneration amplitude on hydrogen following from this suggestion are obtained. (auth)

25417 (JINR-P2-5603) TEST OF MODELS FOR THE ASYMPTOTIC BEHAVIOR OF THE π^+p SCATTERING AMPLITUDES. Dumbrais, O. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1971. 6p. (In Russian). Dep. NTIS (U. S. Sales Only).

Many different models have recently been proposed to explain the Serpukhov data on the π^+p total cross section above 20 GeV, so that considerable ambiguity remains in the theoretical description of π^+p scattering at high energies. It is shown that a simple finite-energy sum rule provides a strong consistency test of models for the asymptotic behavior of the amplitudes. In particular, the hypothesis that the π^+p total cross sections have already reached their limits at 30 GeV can be confirmed by the sum rule. (auth)

25418 (ORO-2504-151) PARTIAL WAVE ANALYSIS OF K^+p ELASTIC SCATTERING. Technical Report No. 70-101. Barnett, B.; Goldman, J.; Laasanen, A.; Steinberg, P. H. (Maryland Univ., College Park. Dept. of Physics and Astronomy). Apr 1970. Contract AT(40-1)-2504. 22p. Dep. NTIS.

A partial-wave analysis of K^+ + p elastic scattering at 0.78 to 1.45 GeV/c is described. The purpose of this analysis is to determine whether a previously found bump in the K^+p total cross sections at 1.2 GeV/c is due to a resonance in the direct channel, generally referred to as Z_1^*. It is found that a persistent feature of all the solutions is the suggestion of a counter-clockwise rotation of the $P_{1/2}$ partial-wave amplitude on the Argand plot. However, reluctance is stated in offering this result as significant evidence for a Z^* (1830). (J.F.P.)

25419 BACKWARD ρ^+-PRODUCTION IN THE STRONG-ABSORPTION MODEL. Myrheim, J. (Univ. of Oslo). Lett. Nuovo Cim.; 1: 221-3(30 Jan 1971).

In the calculation of backward ρ^+ production in $\pi^+ + p \rightarrow p + \rho^+$ in the strong-cut Reggeized absorption model, a previous scheme was followed which implies a nucleon plus delta Regge-pole plus cut amplitude, and parameter values from a previous fit to other backward reactions were used. The measured and predicted differential cross sections at 5 and 5.2 GeV/c and the ρ^+ density matrix elements at 5.2 GeV/c are shown. (J.F.P.)

25420 SUGGESTED INVERSE ELECTROPRODUCTION EXPERIMENT NEAR THE N*(1236) RESONANCE. Karatchentzeff, M.; Kessler, P. (College de France, Paris). Lett. Nuovo Cim.; 1: 96-100(16 Jan 1971).

An isobar model including Born terms is used to study the inverse electroproduction in the reaction $\pi^- + p \rightarrow e^+(\mu^+) + e^-(\mu^-) + n$ near the $\Delta(1236)$ resonance. The differential and total cross sections for these reactions are calculated. (J.F.P.)

25421 A_2 TRAJECTORY IN THE REACTION $\pi^-p \rightarrow \eta n$. Spiro, M.; Derem, A. (CNE, Saclay, France). Lett. Nuovo Cim.; 1: 81-2(16 Jan 1971).

Using a previous energy-dependent method low-energy data for the reaction $\pi^-p \rightarrow \eta n$, the effective Regge trajectory was redetermined. The results are given for the energy regions 2.5 to 5, 3.5 to 6, and 4 to 20 GeV/c. (J.F.P.)

25422 REGGE CUTS AND ISOBAR PRODUCTION. Sundaram, A. (Inst. of Mathematical Sciences, Madras). Lett. Nuovo Cim.; 1: 177-84(30 Jan 1971).

The Regge pole and cut model with SU(3) and exchange degeneracy is found to give a reasonable fit to existing data for the processes $\pi^+ + p \rightarrow \pi^0(\eta^0) + \Delta^{++}$ and $K^+ + p \rightarrow K^0 + \Delta^{++}$. The differential cross sections are shown and compared with experiments. (J.F.P.)

25423 STUDY OF REGGE POLE AND ABSORPTIVE CUT MODELS IN MESON BARYON BACKWARD SCATTERING. Hayot, Fernand. Stony Brook, N. Y.; State Univ. of New York (1970). 90p. University Microfilms Order No. 71-3165.

Thesis.

Regge pole and absorptive cut models in meson baryon backward scattering were studied. The wrong signature nonsense (WSN) model and the diffraction model are considered. It is found that the dip structure is not a characteristic of the diffraction model. Although both models give a good description of πN elastic backward scattering, with a simple pole residue parametrization and the exchange of linear N_α and Δ_δ trajectories, both fail to accommodate the two different dip structures, which are experimentally found in $\pi^+p \rightarrow p\pi^+$ and $\pi^-p \rightarrow n\pi^0$. There exists no satisfactory description in any model of reactions with strangeness exchange. Moreover, SU(3) invariance of the crossed channel partial wave pole residue functions is investigated in reactions with strange and nonstrange exchanges. It is possible to relate $K^-n \rightarrow A\pi^-$ to backward πN scattering, because $K^-n \rightarrow A\pi^-$ is dominated by the N_α trajectory in the backward direction. The symmetric octet coupling has a value close to that found at the particle poles. (Diss. Abstr. Int., B)

25424 FINITE ENERGY SUM RULES AND THEIR APPLICATIONS. Chavda, Lakha Khima. Lafayette, Ind.; Purdue Univ. (1970). 82p. University Microfilms Order No. 71-2577.

Thesis.

The analyticity constraint has been used to derive various kinds

of finite energy sum rules. A brief historical sketch of the evolution of dispersion theory is given. A simple and rigorous derivation of finite-energy sum rules is presented. The use of finite contours in deriving finite energy sum rules is justified and the underlying assumptions clarified. Duality is derived as a consequence of certain reasonable assumptions. A double moment rule is employed to investigate whether or not α_P, the intercept of the Pomeranchuk Regge trajectory, deviates from its maximal value of unity. This sum rule contains a continuously varying power of the amplitude, in addition to the usual continuously varying moment. It is applied to pion nucleon forward scattering. Two particular cases, corresponding to the first and second powers of the amplitude, are analyzed in terms of a Regge pole model with three vacuum trajectories P, P′, P″. The two resulting solutions agree within the errors. Both give excellent fits to high energy data. They have essentially the same value $\alpha_P = 0.988 \pm 0.01$. This value is favored over unity although consistent with the latter. It is found that two-pole models disagree either with the sum rule or with the high energy data. A modified finite energy sum rule is derived. It has a continuously varying moment and involves only the absorptive part of the amplitude. It gives $\alpha_P = 0.66 \pm 0.02$ for the intercept of the ρ-Regge trajectory. This value is in excellent agreement with the one obtained by Foley et al., by direct fitting of high-energy total cross sections. No evidence is found for the ρ'-trajectory. By making an additional assumption, commonly made finite transform sum rules are derived based on Fourier, Hankel and other transforms. Tests for these sum rules are proposed for pion nucleon forward scattering. (Diss. Abstr. Int., B)

25425 REGGE POLE MODELS OF HIGH ENERGY SCATTERING. Gajdicar, Thomas Joseph. Toronto; Univ. of Toronto (1969). National Library of Canada, Ottawa.

Thesis.

A review of Regge pole theory in high energy relativistic scattering is given in which the pion–nucleon system is singled out for specific consideration. Included is a discussion of the Reggeization of higher spin amplitudes and a number of Regge representations. An outline of various high energy experimental results which theory should be able to explain is presented along with a comparison of Regge theory to some presently available experimental data. The applicability of high energy Regge theory is investigated by use of Coulomb interference data from $\pi-N$ elastic scattering. This investigation shows that a discrepancy exists between the theory in the $\pi-N$ case, and the present methods of analyzing the Coulomb interference effects. Two Regge pole models are presented which describe the data associated with the charge exchange processes $\pi p \to \pi^0 n$, and $\pi p \to \eta n$. A $\rho + \rho'$ model, which makes use of superconvergent sum rules, is applied to the first reaction. It is able to describe the present data, including the nonzero polarization observed for this reaction. The second charge exchange reaction is described by means of a dipole A_2 Regge trajectory with encouraging results. Some aspects of the theory of higher multiplicity poles in the S matrix are studied and it is concluded that double poles provide a possible semi-phenomenological description of a number of experimental results with a minimum of parametrization. Finally, in connection with the dipole A_2 model, a multichannel model is presented as a possible means of explaining the various resonance activities of the reaction, $\pi + N \to N + \pi$'s, in the mass region of the A_2 meson. (Diss. Abstr. Int., B)

25426 POMERANCHUK THEOREM VIOLATION AND NEAR-FORWARD ZEROS OF THE DIFFERENTIAL CROSS SECTION AT HIGH ENERGIES. Roy, S. M. (CERN, Geneva). Phys. Lett.: 34B: 407-11(15 Mar 1971).

It is shown that, if $\lim_{s\to\infty} [\sigma_{tot}^{\pi^-p}(s) - \sigma_{tot}^{\pi^+p}(s)] = \Delta\sigma$, $\lim_{s\to\infty} [\sigma_{tot}^{\pi^-p}(s) + \sigma_{tot}^{\pi^+p}(s)]/\ln s = 0$, and $\lim_{s\to\infty} \text{Inf}\ [(2/\pi^3)m_\pi^2(\Delta\sigma)^2/\sigma^{\pi^-p\to\pi^0n}_{\text{non-flip}}(s)] \equiv R$, and if isospin invariance holds, then the helicity non-flip differential cross-section ratios $[(d\sigma/dt)/(d\sigma/dt)_{t=0}]^{\pi^\pm p\to\pi^\pm p}$ must have: i) zeros at momentum transfers $t \underset{s\to\infty}{\sim} -\text{const.}(\ln s)^{-2}$ if $R \geq 0.865$, ii) forward peaks with widths proportional to $(\ln s)^{-2}$ if $R > 1/4$. (auth)

25427 CURRENT ALGEBRA ON THE MASS-SHELL. Snellman, H. (Kungliga Tekniska Hoegskolan, Stockholm). Phys. Scr.; 1: 217-23(1970).

Pion-nucleon scattering on the mass-shell is studied in a field-theoretical framework where the weak currents together with their divergences are taken as interpolating fields for mesons and where the currents obey the Gell-Mann current-algebra (CA) scheme. On the mass-shell the PCAC assumption has a clear physical meaning and the condition for not having any polynomial high-energy behavior in the πN scattering amplitude is an on mass-shell form of the Adler–Weisberger sum-rule. With this sum-rule $g_A(m_\pi^2) = 1.25 \pm 0.02$ is found which is consistent with $g_A(0) = 1.23 \pm 0.01$, the experimental value. The CA and PCAC πN threshold formula is discussed and finite mass corrections to the soft pion limit are considered. Finally the condition for the absence of polynomial high-energy behavior is expressed in field-theoretic language as a new current commutation relation. (auth) (Sweden)

25428 COMPLEX REGGE POLES AND LINE REVERSED REACTIONS. Roy, D. P. (Rutherford High Energy Lab., Chilton, Eng.): Kwiecinski, J.; Desai, B. R.; Zachariasen, F. Phys. Lett.; 34B: 512-16(29 Mar 1971).

The theory of complex Regge poles is invoked to explain the experimental data on the ratio of cross-sections for line reversed pairs of hypercharge exchange reactions. The data behave as should be expected theoretically. (auth)

25429 LARGE ANGLE SCATTERING AND DUAL MODELS. Krzywicki, A. (CERN, Geneva). Phys. Lett.; 34B: 519-23 (29 Mar 1971).

For a wide class of dual models a simple relationship is established between the fixed momentum transfer and fixed angle asymptotic, high-energy behavior. A successful application to the problem of large angle K–N scattering (in connection with a recent experiment at 5 GeV/c) is described. Implications of our results for the phenomenology of large angle scattering are discussed. (auth)

25430 DUALITY IN $\bar{K}N \to \pi\Lambda$, $\pi\Sigma$. Ferro-Luzzi, M.; Shepard, H. K.; Kernan, A.; Poe, R. T.; Shen, B. C. (Univ. of California, Riverside). Phys. Lett.; 34B: 524-7(29 Mar 1971).

The duality diagram predictions for the reactions $\bar{K}N \to \pi\Lambda$ and $\bar{K}N \to \pi\Sigma$ were tested in the energy region 1500 MeV $< E_{cm} <$ 1900 MeV. The $\pi\Lambda$ amplitudes are consistent with the predictions, but the exotic $I_t = 3/2$ amplitudes in $K^-p \to \pi^+\Sigma^-$ do not show local averaging to zero. Within the limited size of our energy interval the $I_t = 1/2$ and the helicity non-flip amplitudes show better local averaging than the $I_t = 3/2$ and the flip amplitudes. (auth)

25431 MEASUREMENT OF NEUTRON–PROTON CHARGE EXCHANGE SCATTERING AT 8, 19, AND 24 GeV/c. Engler, J. (Institut fuer Experimentelle Kernphysik, Karlsruhe, Ger.): Horn, K.; Moennig, F.; (and others). Phys. Lett.; 34B: 528-32(29 Mar 1971).

The t-dependence of the differential cross section for elastic neutron–proton charge exchange scattering was measured at 8, 19.2, and 24 GeV/c. The extremely narrow peak in the forward direction, previously observed for momenta up to 8 GeV/c, persists at the higher momenta, and the t-dependence shows practically no change with energy. Approximate values of the absolute cross section were also determined for these momenta. (auth)

25432 HYPERON RESONANCES, 70. Conference Held at Durham, North Carolina, April 24–25, 1970. Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Company (1970). 522p. (CONF-700416).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

The conference included 43 papers 10 of which were abstracted previously in NSA. For abstracts of these papers see CONF 700416 in a cumulative Report Number Index. Separate abstracts were prepared for 33 papers. (J.F.P.)

For abstracts of individual papers see: 25286, 25307–25309, 25319–25332, 25433–25444, and 25462–25464.

25433 $\bar{K}N$ INTERACTION BETWEEN 400 AND 1200 MeV/c: FIRST ATTEMPT TO AN ENERGY INDEPENDENT PARTIAL WAVE ANALYSIS IN THE $\bar{K}N$, $\Sigma\pi$, AND $\Lambda\pi$ CHANNELS. Armenteros, R. (CERN, Geneva); Baillon, P.; Bricman, C.; (and others). pp 123-51 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

The reactions $\bar{K}N \to \bar{K}N$, $\bar{K}N \to \Sigma\pi$ and $\bar{K}N \to \Lambda\pi$ were analyzed in terms of partial waves. The data employed come from a series of bubble chamber exposures to K^- with momenta ranging between ~400 and ~1200 MeV/c. The method adopts a parametrization for the energy dependence of a restricted number of partial waves and uses the continuity of the data over the entire region to obtain the remaining waves. (auth)

25434 MULTICHANNEL K MATRIX ANALYSIS OF anti KN INTERACTION IN THE REGION 0 TO 1200 MeV/c. Kim, Jae Kwan (Harvard Univ., Cambridge, Mass.). pp 161-8 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

A multichannel phase shift analysis was performed on the experimental data for $\bar{K} + N$ interactions below 1200 MeV/c. The K matrix parametrization was used. The preliminary results of the Argand diagrams of the reaction amplitudes and the estimated

resonance parameters in the energy region are presented. Some baryon resonances are indicated. (J.F.P.)

25435 PARTIAL WAVE ANALYSIS OF $K^-N \to \Lambda\pi$ BETWEEN 1 AND 1.85 GeV/c. Litchfield, P. J. (Rutherford High Energy Lab., Chilton, Eng.). pp 215-21 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

A partial-wave analysis is carried out on all published data for the reactions $K^- + p \to \Lambda + \pi^0$ and $K^- + n \to \Lambda + \pi^-$ at 1.0 to 1.85 GeV/c. In this analysis the free parametrization of partial waves is used without prior assumption as to their nature. The coefficients of fits to the differential cross sections and partial wave amplitudes are shown. (J.F.P.)

25436 REGGE POLE ANALYSIS OF THE REACTION $K^-p \to \Xi^0(1530)K^0$. pp 307-12 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

A phenomenological Regge pole analysis of the reaction $K^- + p \to \Xi^0(1530) + K^0$ in the energy range from 1.7 to 2.87 GeV/c is presented in terms of Σ exchanges. An attempt is made to fit the Reggeized sigma model to the entire angular distribution. The resulting fits to the angular distribution and the energy dependence of the differential cross sections are shown. (J.F.P.)

25437 K^+p PHASE-SHIFT ANALYSIS AND A Z. Yokosawa, A. (Argonne National Lab., Ill.). pp 367-74 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

The research carried out on $K^+ + p$ polarization measurements and phase shift analysis is summarized for the purpose of clarifying the status of the Z^*. (J.F.P.)

25438 STRUCTURE OF THE K^+p AMPLITUDES IN THE REGION OF THE COOL BUMP. Erne, F. C.; Sens, J. C.; Wagner, F. (CERN, Geneva). pp 375-400 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

An updated and extended energy-independent phase-shift analysis at the elastic K^+p channel from threshold to 1.9 GeV/c is presented. Several solutions show a resonance-like behavior in the P_3-wave in the region of the bump at 1.25 GeV/c in the total cross-section. The compatibility of these solutions with other analysis of the elastic and inelastic channels, and with production experiments, is discussed. (auth)

25439 PARTIAL WAVE ANALYSIS OF K^+p ELASTIC SCATTERING. Barnett, B.; Goldman, J.; Laasanen, A.; Steinberg, P. H. (Univ. of Maryland, College Park). pp 443-5 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

Some results of a partial-wave analysis of elastic $K^+ + p$ scattering near the bump at 1.2 GeV/c in the total cross sections are presented. The analysis is carried out at momenta between 0.78 and 1.45 GeV/c and uses all available cross section and polarization data. A possible Z^* is found with a mass of 1840 MeV and a width of 80 MeV. (J.F.P.)

25440 K^+p PHASE SHIFT ANALYSIS: AN ALTERNATIVE SOLUTION. Carreras, B. (Daresbury Nuclear Physics Lab., Eng.); Donnachie, A.; Kirsopp, R. G. pp 447-51 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

The results of an energy-dependent study of $K^+ + p$ elastic scattering are used as input to an energy-independent phase shift analysis of $K^+ + p$ elastic scattering. The energy range studied is from 0.355 to 1.970 GeV/c. The final results with errors which were obtained for the phase shifts and elasticities for S_{11}, P_{11}, P_{13}, D_{13}, and D_{15} are tabulated. Resonances were not found to be associated with these waves. (J.F.P.)

25441 DUALITY AND THE BARYON SPECTRUM. Capps, Richard H. (Purdue Univ., Lafayette, Ind.). pp 465-6 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

A discussion is given of the result of applying a simple duality principle to the meson–baryon states that are exotic. This principle is combined with the assumption that the residues are SU(3) invariant. (J.F.P.)

25442 BRIEF SUMMARY OF BARYON SPECTRUM AND ITS INTERPRETATION ACCORDING TO THE QUARK MODEL. Feld, B. T. (Massachusetts Inst. of Tech., Cambridge). pp 467-9 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

A summary is given of the current status of the spectrum of baryonic states taking into account the new data and identifications. This summary is presented in the form of a table in which an attempt is made to classify the levels according to the predictions of a quark model. (J.F.P.)

25443 COMMENTS ON BARYON SPECTROSCOPY. Meshkov, Sydney (National Bureau of Standards, Washington, D. C.). pp 471-500 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

The review of baryon spectroscopy covers the definition of resonances, classification criteria, configuration mixing and its effect on masses, and the SU(3) and SU(6), the SU(6) × O(3), and higher-spin-state classifications. (J.F.P.)

25444 PREDICTION OF SLOPE CHANGES IN KAON–NUCLEON SCATTERING. Libby, L. M. (Univ. of Colorado, Boulder). pp 501-5 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

The prediction of slope changes in K + N scattering is given starting from the relativistic relation between the cross section and matrix element for the elastic scattering. The effect of Lorentz contraction is also taken into account. (J.F.P.)

25445 GENERALIZED VENEZIANO MODEL FOR REACTIONS WITH PION EXCHANGE. Pokorski, S.; Szeptycka, M.; Zieminski, A. (Univ., Warsaw). Nucl. Phys.; B27: 568-88(1971).

The generalized Veneziano model is applied to the following reactions dominated by pion exchange: $\pi^-p \to \pi^-\pi^+n$, $\pi^+p \to \pi^+\pi^-N^{*2+}$, $K^-p \to K^-\pi^+n$ and $K^+p \to K^+\pi^-N^{*2+}$ in the lab momentum range from 5 to 16 GeV/c. The dual amplitudes are "unitarized" (different total widths are given to resonances on parent and daughter trajectories). The pomeron exchange contribution is also included. Most of the experimental distributions are satisfactorily described by the model. (auth)

25446 RADIATIVE PION NUCLEON SCATTERING. Baier, R.; Pittner, L.; Urban, P. (Univ., Graz). Nucl. Phys.; B27: 589-97(1971).

Starting from an effective Lagrange function for the pion–nucleon system relativistic covariant and gauge invariant amplitudes for radiative pion–nucleon scattering are constructed. Cross sections for the process $\pi^+p \to \pi^+p\gamma$ are calculated and compared with the predictions of the static model and with off-mass-shell current algebra calculations. (auth)

25447 N/D CALCULATIONS FOR THE P_{33} πN PARTIAL WAVE WITH EFFECTIVE LAGRANGIAN INPUT. Engels, J.; Fleischer, J. (Univ., Karlsruhe, Ger.). Nuovo Cim.; 2A: 384-92 (21 Mar 1971).

The question of whether or not effective Lagrangians can be used above threshold is investigated in the case of the P_{33} πN partial wave. It turns out that for energies below the resonance position of the N^* the l.h. cut is improved compared to the nucleon Born term; however, at higher energies the Lagrangians l.h. cut is too large. The corresponding phase calculated by means of the N/D method is below the resonance position in good agreement with the experimental result. At higher energies it is much better than previous calculations which used only the nucleon Born term as input; it is, however, still too low. The reason for the difference is that a method was used which corresponds to the inclusion of a CDD pole. (auth)

25448 MESON MULTIPLICITY IN HIGH-ENERGY COLLISIONS. Hoang, T. F. (Argonne National Lab., Ill.). Nuovo Cim.; 2A: 467-88(21 Mar 1971).

The Poisson distribution for meson multiplicity is modified to take into account the geometric factor describing the overlapping volume of two particles in collision. Various models are tested with the following high-energy data: 16 and 25 GeV/c π^-p experiments by the Aachen–Berlin–Bonn–CERN–Cracow–Hamburg–

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Warsaw collaboration and the Wisconsin group, respectively, and 28.5 GeV/c p–p experiment by Berkeley. The modified Poisson distribution gives a better fit than the currently used Poisson distribution. Consistent tests do not justify the validity of Wang's conjecture that two mesons of opposite charge are emitted as a pair to conserve the electric charge. A discussion is presented on K-meson production by π^-p collision of Wisconsin data and π production in p–p annihilation of Bonn–Hamburg–Milan and Yale experiments. (auth)

25449 STUDY OF SOME THREE-BODY REACTIONS IN π^+d INTERACTIONS AT 5.1 AND 9.0 GeV/c. Murro, O.; Picciarelli, V. (Univ., Bari, Italy. Istituto Nazionale di Fisica Nucleare, Bari, Italy). Nuovo Cim.; 2A: 514-24(21 Mar 1971).

Some three-body reactions obtained in π^+ interactions on deuterium at 5.1 and 9.0 GeV/c of incident momentum are studied. The analysis is made in the longitudinal phase space. The results show the presence of a Pomeranchuk exchange in the region $\omega < 120°$. (auth)

25450 REGGE QUARK MODEL FOR $0^-1/2^+ \to 0^-1/2^+$ SCATTERING. Moore, R. W.; Moriarty, K. J. M.; Migneron, J. H. R. (Imperial Coll. of Science and Tech., London). J. Phys., A (London); 4: 244-65(Mar 1971).

Results are presented of a Regge quark model fit to 2 body charge exchange and elastic $0^-1/2^+ \to 0^-1/2^+$ scattering. Both constant and exponential t-dependent residues are used; the latter giving the better description of the data. (auth) (UK)

Strong (Baryon No. ≥ 2)

Refer also to abstract 25300.

25451 (DEMO–70/24) ANALYTIC SOLUTIONS OF THE REFERENCE SPECTRUM EQUATION. Grypeos, M. E. (Democritus Nuclear Research Center, Athens (Greece)). Nov 1970. 24p. Dep. NTIS (U. S. Sales Only).

Analytic solutions of the fundamental equation of the reference-spectrum method for nuclear matter are obtained in the cases of the square-well and exponential potentials with hard cores. In the former case, analytic wave functions are obtained for every partial wave L. These wave functions are expressed in terms of spherical Bessel and Hankel functions or in terms of spherical Bessel, Hankel, and Neumann functions of order L. In the latter case, an analytic expression is obtained for the s-wave function only. This is given in terms of the transcendental functions $G_{L\nu}(r)$ and $M_{L\nu}(r)$, which are defined as series of well-known functions. Finally, an application is made to the calculation of the well depth of a Λ particle in its ground state in nuclear matter. (auth)

25452 (JINR–P2-5546) EFFECT OF THE RESONANCE PRODUCTION ON THE NUCLEAR REACTION MECHANISM. Il'inov, A. S.; Toneev, V. D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1970. 13p. (In Russian). Dep. NTIS (U. S. Sales Only).

The resonance production processes are taken into account in the framework of the cascade model. It is shown that variation in the nuclear reaction mechanism, occuring at about (3 to 5) GeV in the region of medium-weight nuclei, is explained not by the effect of resonances, produced in the internuclear particle collisions, but by the previously considered effect of the local reduction of the nuclear density in proportion to the cascade development. It is pointed out that the contribution of the "many-particle" collisions is unessential in the energy region T < 30 GeV. (auth)

25453 (JINR–P2-5604) AMPLITUDE AND CROSS SECTION OF THE COHERENT PRODUCTION OF STABLE AND UNSTABLE PARTICLES IN THE COLLISIONS OF FAST PARTICLES WITH NUCLEI. Gevorkyan, S. R.; Tarasov, A. V.; Tseren, Ch. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1971. 15p. (In Russian). Dep. NTIS (U. S. Sales Only).

The closed expressions for the amplitude of the coherent resonance production on nuclei with the account of the produced resonance widths are obtained. It is shown that at a certain energy range the account of the final resonance width changes essentially the cross sections. (auth)

25454 (JINR–P3-5548) INTERACTION OF RELATIVISTIC DEUTERIUM AND TRITIUM NUCLEI WITH THE PHOTOEMULSION ONES. Barashenkov, V. S.; Il'inov, A. S.; Toneev, V. D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1970. 12p. (In Russian). Dep. NTIS.

Inelastic collisions of the deuterons and tritium nuclei with the photoemulsion ones in the energy range up to 30 GeV/nucleon were calculated within the framework of the intranuclear cascade model taking account of the changes in the nucleus-target properties in the process of interaction. In the energy dependence of the slow secondary particle multiplicity at the energy of the order of several GeV the maximum is predicted which is due to the decrease of the intranuclear matter density resulting from the knocking out of nucleons by the cascade particles. Reliability of the selection of interactions with photoemulsion hydrogen with the aid of the $n_h \leq 1$ criterion is discussed. (auth)

25455 (ORNL-tr–2452) INTRANUCLEAR CASCADES WITH ALLOWANCE FOR α-CLUSTERS. Barashenkov, V. S.; Abdinov, O. B. Translated for Oak Ridge National Lab., Tenn., from Acta Phys. Pol.; B1: 65-70(1970). 7p. Dep. NTIS.

The model of intranuclear cascades in a light nucleus with allowance for direct interactions of cascade protons with α-clusters is considered using the inelastic interactions of 660-MeV protons with carbon nuclei as an example. At this stage limitation is made to a consideration of a model with a sharp nuclear boundary and uniform distribution of α-clusters. The results of calculations of the angular and energy distributions of secondary protons, the distribution of excitation energies and of the yield of residual nuclei are slightly dependent on the parameters of the cluster model. The experiments and calculations for the α-particles produced are in agreement only when the α-clusters are taken into account. The best agreement with the experiment is reached if the probability of coagulation of nucleons into α-clusters is about 20%. (auth)

25456 NONSTATIC CORRELATIONS TO THE HIGH-ENERGY NUCLEAR ELECTRON ELASTIC SCATTERING. D'Auria, R. (Istituto Nazionale di Fisica Nucleare, Turin); Molinari, A.; Napolitano, E. Lett. Nuovo Cim.; 1: 83-6(16 Jan 1971).

A new way of using the closure approximation method for estimating the second-order nonstatic correction to the electron elastic scattering by nuclei is proposed. It is concluded that a modification of the usual phase-shift analysis of elastic electron scattering in diffraction minima comes only through the nuclear surface. (J.F.P.)

25457 SUM RULES FOR $\Xi\Xi$, $\Sigma\Sigma$, AND $\Lambda\Lambda$ SCATTERING AMPLITUDES. Grigoryants, A. G.; Filkov, L. V. (Moscow Inst. of Physics). Yadern. Fiz.; 12: 1249-61(Dec 1970). (In Russian).

Sum rules for $\Xi\Xi$, $\Sigma\Sigma$, and $\Lambda\Lambda$ scattering amplitudes are obtained. Considering the combination of the sum rules and the vector-meson dominance for the electromagnetic formfactors of the Ξ, Σ, and Λ hyperons one is able to get the hyperon-meson coupling constants for the mesons that contribute to the $\Xi\bar{\Xi}$, $\Sigma\bar{\Sigma}$, and $\Lambda\bar{\Lambda}$ scattering. Results of the sum rule for the $\Sigma\Sigma$ scattering amplitude are also the mass relations $\mu_B^2 \approx m_\Sigma^2$, $\mu_{A_1}^2 \simeq m_\Sigma^2$ that are in reasonable agreement with the experiment. (auth)

25458 ELASTIC $\pi^- - {}^{12}C$ SCATTERING AROUND THE 3–3 RESONANCE: A COMPARISON BETWEEN GLAUBER'S THEORY AND KISSLINGER'S MODEL. Maillet, J. P.; Schmit, C.; Dedonder, J. P. (Institut de Physique Nucleaire, Orsay, France). Lett. Nuovo Cim.; 1: 191-6(30 Jan 1971).

Results for π^- elastic scattering by carbon-12 previously obtained using the Kisslinger model are compared with results for the Glauber model. Differential and total cross sections at 100 to 300 MeV are shown. Also a comparison is given between the approximations used in these models. (J.F.P.)

25459 INTERPRETATION OF PARTIAL p WAVES OF PROTON–PROTON SCATTERING. Lend'el, V. I.; Tovtin, E. V. (Uzhgorod State Univ., USSR). Ukr. Fiz. Zh. (Russ. Ed.); 15: 1761-4(Nov 1970). (In Russian).

The calculations of p-waves (l = 1) of pp-scattering is carried out in the framework of one-boson-exchange model. It is shown that the experimental data are satisfactorily described without taking into account the unitary cuts (except for $^3p_0$-wave) at coupling constants values which were used when considering other partial waves. (auth)

25460 MONTE-CARLO CALCULATION OF ANTIPROTONS ANNIHILATING (AT REST) IN NUCLEI, USING THE ISOBAR MODEL. Mes, H.; Hebert, J. (Univ. of Ottawa). Can. J. Phys.; 49: 441-6(15 Feb 1971).

A Monte-Carlo calculation was used to simulate antiprotons annihilating (at rest) with the nuclei of the emulsion. Assuming that the final product of the annihilation is pions, the latter can interact with the nucleons to form isobars. The fate of these isobars inside the nucleus determines the ratio of absorbed to scattered pions. Two distinct cases are considered. (auth) (Canada)

25461 CANCELLATION OF INTERNAL BREMSSTRAHLUNG FOR RELATIVISTIC PARTICLES. Dittrich, J. (Charles Univ., Prague); Janouch, F. Phys. Lett.; 34B: 363-5(15 Mar 1971).

The conditions for internal bremsstrahlung (IBS) cancellation are discussed for the scattering of relativistic particles. Kinematical conditions for the cancellation of IBS radiation accompanying the p−p scattering are given. (auth)

25462 ISOTOPIC SPIN ANALYSIS OF K^+p AND K^+d TOTAL CROSS SECTIONS. Dowell, J. D. (Birmingham Univ., Eng.). pp 53-7 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

An isotopic spin analysis along the lines of previous work was carried out for the total cross sections of $K^+ + p$ and $K^+ + d$ interactions. The effect of smearing by the Fermi motion in the deuteron and the Glauber−Wilkin correction are taken into account. (J.F.P.)

25463 CONSTANT K-MATRIX FIT TO KN DATA UP TO 430 MeV/c. Thompson, J. (Brookhaven National Lab., Upton, N. Y.). pp 61-9 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

The Dalitz−Tuan constant K-matrix formalism, which explicitly includes the unitarity conditions and has fewer parameters than a K-matrix with effective ranges, is used to fit K + p data up to 430 MeV/c. Several similar fits with R = (X^2/degrees of freedom) ranging from 1.52 to 1.63 were found for data in the momentum range 0 to 430 MeV/c, but no fit with R < 1.86 was found when the data and 450 MeV/c were included. The parameters of the fit are given. (J.F.P.)

25464 DETERMINATION OF THE $\bar{K}YP$ COUPLING CONSTANTS: THE IMPORTANCE OF THE LOW ENERGY $\bar{K}N$ DATA. Lasinski, T. A. (Univ. of Chicago). pp 85-94 of Hyperon Resonances, 70. /Fowler, Earle C. (ed.). Durham, N. C.; Moore Publishing Co. (1970).

From International conference on hyperon resonances; Durham, N. C. (24 Apr 1970). See CONF-700416.

An attempt is made to summarize the $\bar{K}Yp$ coupling constant determinations. The importance of the low-energy $\bar{K}N$ data to the calculations is stressed. A sum rule for $g^2_{K\Lambda p}/4\pi$ and K-matrix fits and below threshold contributions are discussed. (J.F.P.)

25465 WHY IS THE 33-RESONANCE SHIFTED IN NUCLEI? Locher, M. P. (Schweizerisches Institut fuer Nuklearforschung, Zurich); Steinmann, O.; Straumann, N. Nucl. Phys.; B27: 598-604(1971).

Forward π-nuclear elastic scattering in the region of the $\pi-N$ resonance is discussed within the Glauber model. A simple expression which shows that the cross section in the nucleus always peaks at a lower energy, whereas the zero of the real part of the amplitude remains unchanged. Particularly the shift in $\sigma_T 12_C$ is about 50 MeV in agreement with experiment and other calculations. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstracts 25271, 25493, 25507, and 25525.

25466 (IAE-1988) STATEMENT OF A PROBLEM FOR EIGENVALUES FOR A GROUP OF PERMUTATIONS. Gaponov, Yu. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Atomnoi Energii). 1970. 10p. (In Russian). Dep. NTIS (U. S. Sales Only).

It is suggested that an additional group of operators constructed for a group of permutations S_N be included in the full set of commutating operators of system N to describe the permutational symmetry properties of the system. The corresponding sets are studied for systems of identical and nonidentical particles. (JPRS)

25467 (JINR-P2-5625) PECULIARITIES OF APPLICATION OF THE LIE GROUP THEORY TO THE NON-RELATIVISTIC TRANSFORMATIONS. Streltsov, V. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1971. 6p. (In Russian). Dep. NTIS (U. S. Sales Only).

The peculiarities of application of the Lie group theory to the case of nonrelativistic transformations are discussed. (auth)

25468 (JINR-P2-5692) ALGEBRAIC REALIZATION OF CHIRAL SU(3) x SU(3) SYMMETRY. Ogievetskii, V. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1971. 28p. (In Russian). Dep. NTIS (U. S. Sales Only).

The algebraic realization of the nonlinear chiral SU(3) × SU(3) symmetry which is linear only on its good isospin-hypercharge subgroup SU(2) × Y is considered. It is shown that particles of any given helicity must be assembled into supermultiplets of chiral SU(3) × SU(3). At the same time the mass squared matrix m^2 is proven to contain besides the invariant part the eighth and zero components of the (3,3*) + (3*,3) representation of SU(3) × SU(3) in accordance with the Gell-Mann−Oakes−Renner hypothesis. Also some additional restrictions on m^2 are derived. (auth)

25469 MULTIPARTICLE STATES WITH SPIN-INDEPENDENT POINCARE TRANSFORMATION PROPERTIES. Tindle, Graham L. (Queen Mary Coll., London). Phys. Rev., D; 3: 1468-85 (15 Mar 1971).

Systems of noninteracting particles are considered, in terms of standard on-mass-shell states and direct-product helicity states. Three complete classes of multiparticle states with spin-independent Poincaré transformation properties are defined. No auxiliary spin group is used, and the new "scalar spin" state labels, which are eigenvalues of generalized covariant helicity operators, have a direct physical interpretation in terms of single-particle quantum numbers. In the two-particle case our states are compared with Jacob and Wick's c.m. angular momentum states. (auth)

25470 LINEARIZATION TECHNIQUES IN ALGEBRAIC APPROACHES TO CHIRAL TRANSFORMATIONS. Ndili, F. N. (Daresbury Nuclear Physics Lab., Eng.). Lett. Nuovo Cim.; 1: 203-7(30 Jan 1971).

The conversion of nonlinear realizations of chiral SU(2) × SU(2) into linear ones was previously discussed within the framework of the algebraic approach to chiral transformations, and is now generalized to chiral SU(n) × SU(n). A different formulation is given which is based on Lie algebra, and makes the procedure for setting up the linearization equations for chiral SU(n) × SU(n) rather transparent. (J.F.P.)

25471 SHORT-RANGE REPULSION AND BROKEN CHIRAL SYMMETRY IN LOW-ENERGY SCATTERING. Serebryakov, V. V.; Shirkov, D. V. (Inst. for Mathematics, Novosibirsk, USSR). Fortschr. Phys.; 18: 527-76((1970).

An essentially modified version of previous work on short-range repulsion is given. The concept of chiral symmetry and its consequences are used for the low-energy characteristics of strong interactions as boundary conditions on the solution of dispersion equations. The introduction of the short-range repulsion potentials into the low-energy equations for lower partial waves makes it possible to eliminate the main difficulties of the purely elastic low-energy (Pele) approximation. There is then a possibility in principle of obtaining solutions with small s-wave scattering lengths and broad resonances. The use of threshold conditions resulting from chiral symmetry allows one (under certain additional conditions) to express the main resonance scattering parameters in terms of the pion decay characteristics. Formulas are presented by means of one of which the ρ meson mass m_ρ is expressed in terms of the pion mass μ and the decay constant f_π from the PCAC condition and the other expresses the ρ meson width Γ_ρ via μ, f_π, and m_ρ and is a generalization of the well-known KSFR relation taking into account unitarity corrections. Similar results were obtained for the Δ_{33} resonance in pion−nucleon scattering. Thus using the broken chiral symmetry approximation and unitarity dispersion equations for low-energy $\pi\pi$ and πN scattering the masses, lifetimes, and coupling constants were obtained for p-wave resonances by specifying only the pion and nucleon masses, their lifetimes and the Fermi coupling constant. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstract 25811.

25472 (ISS-70/16) SU(4). IS IT A PLAUSIBLE SYMMETRY FOR HADRONS? Maiani, L. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). 30 Jun 1970. 16p. (CONF-700714-1). Dep. NTIS (U. S. Sales Only).

From International school of subnuclear physics seminar; Trapani, Italy (1 Jul 1970).

A theory of weak interactions is presented based on approximate SU(4) invariance of strong interactions. The theory has a pattern of divergences different from the conventional one. In particular transitions with $\Delta S = 1$ neutral currents are of order

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$G^2+G^3\Lambda^2+\ldots$ and not $G^2\Lambda^2+G^3\Lambda^4+\ldots$ as in the conventional one, and the same is true for the K_S-K_L mass difference. A neutral current with $\Delta S = 0$ can be introduced, and leads to a more symmetrical formulation of the theory, in terms of Yang–Mills fields. The presence of this neutral current can be detected in neutrino experiments, and its predicted strength is compatible with present experimental upper bounds. Consequences of the theory for strong interactions are briefly discussed. (auth)

25473 CURRENT ALGEBRA, BROKEN SU(3) SYMMETRY AND SEMILEPTONIC INTERACTIONS. Desai, Pranav Suresh. College Park, Md.; Univ. of Maryland (1970). 97p. University Microfilms Order No. 71-4032.

Thesis.

Some problems of current interest in elementary particle physics are studied, using the idea of asymptotic SU(3) symmetry. The approach is to assume that the matrix elements of the charge operators V_i, which are the SU(3) generators, are not renormalized by the SU(3) breaking interaction in the appropriately chosen infinite momentum limit, where the momentum transfer squared involved is always zero even in the presence of intramultiplet mass splittings. This assumption, together with the use of the chiral SU(3) × SU(3) charge algebra (involving the vector and the axial-vector charges V_i and A_i) leads to broken SU(3) sum rules among the masses and the physical coupling constants of multiplets of particles. These in turn are used for investigating some important questions of current interest in particle physics. The leptonic decays of hyperons are studied, and in particular, the question of the equality or otherwise of the Cabibbo angles θ_A and θ_V associated with the axial-vector and the vector weak hadronic currents is investigated. The results obtained by using the broken SU(3) sum rules among the weak hadronic couplings, together with the latest experimental data seem to favor the attractive possibility that there is just one Cabibbo angle (i.e., that $\theta_A = \theta_V$). Some electromagnetic corrections to the sum rules are also considered, and are found to maintain the equality of the Cabibbo angles. The effect of weak magnetism in baryon leptonic decays of the type $B \to B'e\nu$ is considered. An expression for the final baryon spin-lepton momentum correlation is derived valid to first order in $\beta \equiv m_B - m_{B'}/m_B$. The expression may be useful in future experimental determination of the weak-magnetic form factor for various baryon leptonic decays. An attempt is made to determine the range of parameters associated with a possible normal scalar meson nonet. In contrast to most of the previous attempts, the validity of exact SU(3) symmetry is not assumed, but only the broken SU(3) sum rules obtained through the use of the asymptotic SU(3) symmetry are employed. In order to obtain further constraints (in addition to those obtained from the usual charge algebra), certain commutation relations among the time derivatives of the V_i charges and the A_i charges are also considered. The plausibility of assuming these commutators (viz., $[\dot{V}_{K^+}, A_{K^-}] = 0$ and $[\dot{V}_{K^0}, A_{\pi^-}] = 0$) is briefly discussed. The sum rules are rewritten in terms of strong SU(2) invariant SPP coupling constants by using the partially conserved axial-vector current hypothesis for the pion and the kaon. The set of all the sum rules is then used for numerical analysis of the scalar meson parameters, using some criteria obtainable from experimental data. The numerical solution so obtained is found to be compatible with available experimental data. (Diss. Abstr. Int., B)

Applications (Strong)

25474 (ISS-70/25) NON EXISTENCE OF AMBIGUITIES IN SU(3) x SU(3) BREAKING. Mahanthappa, K. T.; Maiani, L. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). 15 Oct 1970. 8p. Dep. NTIS (U. S. Sales Only).

It is shown that a careful treatment of symmetry breaking of SU(3) ⊗ SU(3) does not lead to any ambiguity in the determination of the $(3, \bar{3}) \oplus (\bar{3}, 3)$ breaking lagrangian, contrary to the result of Kuo. (auth)

25475 SYMMETRY PROPERTIES OF ELEMENTARY PARTICLES AND THEIR MODERN ALGEBRAIC TREATMENTS. Wada, Morihiro (Tokai Univ., Hiratsuka, Japan). Proc. Fac. Sci. Tokai Univ.; 5: No. 1-2, 1-73(Mar 1970).

Modern algebraic treatments in the simple Lie algebras of rank 3 are made use of to clarify the structure existing in the behaviors of the strong interactions as well as resonances. The general theoretical frame is presented in order to be able to involve any number of quantum numbers such as isotopic spin, strangeness, baryon number and so on. Three examples are given. (auth) (Japan)

25476 AXIAL-VECTOR CURRENT-FIELD IDENTITY AND SPONTANEOUS SYMMETRY BREAKDOWN. Narayanaswamy, P. (Southern Illinois Univ., Edwardsville). Lett. Nuovo Cim.; 1: 185-90(30 Jan 1971).

It is shown that the current–field identity and the statement of dynamical independence imply that the pion is a Goldstone boson characterizing spontaneous symmetry breakdown. It is shown that an equation of vanishing equal-time commutators is satisfied in theories where the symmetry is broken spontaneously and the physical pion acquires mass as a result of an explicitly symmetry-breaking mechanism. The discussion is valid generally and not restricted to a specific model. (J.F.P.)

25477 [5]CONSISTENCY CONDITIONS FOR CHIRAL SYMMETRY AND SCALE INVARIANCE. II. SCALE NONINVARIANCE OF THE CHIRAL-SYMMETRY LIMIT. [6]Jackiw, R. [8](Massachusetts Inst. of Tech., Cambridge). [14]Contract AT(30-1)-2098. [15]Phys. Rev., D; 3: 1356-9(15 Mar 1971).

If it is required that matrix elements of the SU(3) × SU(3) symmetry-violating operator in the Hamiltonian be gently varying, and that the limits of chiral symmetry and/or scale invariance be smoothly attainable, then scale invariance must be broken in the chiral-symmetry limit. (auth)

25478 CONSISTENCY CONDITIONS FOR CHIRAL SYMMETRY AND SCALE INVARIANCE. I. DIMENSIONS OF OPERATORS. Jackiw, R. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Phys. Rev., D; 3: 1347-55(15 Mar 1971).

It is demonstrated that in the contemporary models of chiral-symmetry and scale-invariance breaking, the matrix elements of the trace of the energy-momentum tensor Θ are necessarily rapidly varying in the low-energy region. It is further shown that the limit of exact scale invariance cannot be achieved smoothly. An alternative energy-momentum tensor is proposed, which is related to the "new improved" tensor with finite matrix elements in perturbation theory, and whose matrix elements do not possess this singular behavior. By demanding maximal smoothness, the scale dimension of the divergence of the axial-vector current is found to be one. (auth)

25479 SCALE-INVARIANCE AND CHIRAL-SYMMETRY BREAKING FOR NUCLEON STATES. Serge, Gino (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Phys. Rev., D; 3: 1360-3(15 Mar 1971).

Assuming that chiral invariance is only broken by terms in the energy-momentum tensor Θ^{00} belonging to the $(3,\bar{3}) + (\bar{3},3)$ representation of SU(3) × SU(3), a sum rule is derived for the matrix element of Θ (the trace of the energy-momentum tensor) between nucleon and pion-nucleon states which may suggest that the divergence of the axial-vector current has dimension 1. An analogous sum rule is considered which suggests that the energy-momentum tensor contains a scale-invariance-breaking chiral singlet term, and finally some implications for SU(3) breaking of the form of matrix elements of Θ are pointed out. (auth)

25480 SU(3) x SU(3), SYMMETRY BREAKING, AND CABIBBO ANGLE. II. Bane, J. C. (Univ. of Colorado, Boulder); Mahanthappa, K. T. Phys. Rev., D; 3: 1446-57(15 Mar 1971).

Bootstrap equations are constructed for symmetry-breaking vectors in $(\bar{3},3) \oplus (3,\bar{3})$ and $(1,8) \oplus (8,1)$ representations of the chiral SU(3) × SU(3) with both electromagnetic and nonleptonic driving terms which, being obtained from a current–current interaction with currents in $(1,8) \oplus (8,1)$ have parts belonging to both octet and 27-plet representations. Only one solution of these equations is chosen by requiring partial conservation of axial-vector current (PCAC) and the Cabibbo angle θ_C to have a nonzero value. It follows directly from the equations that the existence of the weak 27-plet driving term is a necessary condition to have a nonzero θ_C. The solution has the same form as that suggested by Gell-Mann, Oakes, and Renner for a semistrong symmetry-breaking interaction. Knowing the deviation from $\sqrt{2}$ in their work, $\theta_C \approx 0.22$ is obtained. The solution has both parity-conserving and parity-violating nonleptonic weak interactions in $(1,8) \oplus (8,1)$, and hence the strangeness-changing part cannot be rotated away. In this framework the electromagnetic tadpole cannot be in $(\bar{3},3) \oplus (3,\bar{3})$, but it can be in $(8,1) \oplus (1,8)$. (auth)

Field Theories

General

25481 NONSTATIC ELECTROMAGNETIC FIELDS IN GENERAL RELATIVITY. III. De, Nitai Chand (Jadavpur Univ., Calcutta); Datta, Bidyut Kumar. Phys. Rev., D; 3: 1280-3(15 Mar(1971).

The equations of Raininch's "already unified field theory" are studied from the standpoint of continuous groups of motions, and a solution is presented for the case where the electromagnetic field is nonstatic and the space-time admits a three-parameter continuous group of motions whose minimum-invariant varieties are three-dimensional spaces. One may state that, for values of t for which the metric is not singular, the divergence-free electromagnetic fields could appear to be due to some phantom charges which might have pervaded all space at the singular epochs. (auth)

25482 COHERENT STATES AND INDEFINITE METRIC: APPLICATIONS TO THE FREE ELECTROMAGNETIC AND GRAVITATIONAL FIELDS. Gomatam, Jagannathan (Syracuse Univ., N. Y.). Phys. Rev., D; 3: 1292-8(15 Mar 1971).

The "coherent states" are constructed within the framework of an indefinite-metric linear vector space. It is found that these states have positive definite norm and are eigenstates of the annihilation operator. The theory is then applied to the free electromagnetic field and the linearized free gravitational field in the Gupta formulation. The "coherent states," restricted by the weak subsidiary condition, decompose into the usual coherent states involving only the physical degrees of freedom and an orthogonal vector of vanishing norm. (auth)

25483 DERIVATION OF THE NONLINEAR ELECTROSTATIC THEORY FROM GRAVITATIONAL THEORY USING α CORRESPONDENCE. Bredimas, Antoine (Univ., Paris). Compt. Rend., Ser. A; 272: 85-8(4 Jan 1971). (In French).

The analogy between Maxwell's electromagnetic theory and Einstein's gravitational theory, and the α correspondence which it defines has already been demonstrated. The Lagrangian of a nonlinear electrostatic theory is determined from the gravitational Lagrangian using the α correspondence. The equations, the fields and inductions, and the momentum energy tensor and the resulting electrostatic force are studied. (France)

25484 WAVE TAILS IN BORN–INFELD ELECTRODYNAMICS. Chellone, D. S. (King's Coll., London). J. Phys., A (London); 4: 184-96(Mar 1971).

Approximate iterative solutions to the Born–Infeld nonlinear electromagnetic equations are developed in flat space-time. Incoming radiation terms, or wave tails, are shown to arise from the iterative correction of initially purely outgoing approximate solutions. (auth) (UK)

Quantum Field Theory

Refer also to abstracts 25358, 25375, and 25522.

25485 (ITF-70-107-E) GENERAL PROBLEMS OF FIELD THEORY. Hepp, K. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1970. 30p. Dep. NTIS (U. S. Sales Only).

Recent results in quantum field theory in perturbation theory and in axiomatic quantum field theory are reviewed. (J.F.P.)

25486 (JINR–P2-5616) TREE GRAPHS IN THE YANG–MILLS THEORY. Ivanov, E. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1971. 21p. (In Russian). Dep. NTIS (U. S. Sales Only).

The tree graphs are considered in the massless Yang–Mills field theory with the addition $-1/2 \int \partial_\rho b_\mu^i \partial_\gamma b_\nu^i d^4x$ to the action and in the ordinary massive Yang–Mills field theory. In the case of massless theory they are proved to be invariant on the physical subspace with respect to the c-number gradient variations of field and pairings and therefore coincides with the tree part of the S-matrix in the radiative gauge. It is shown that the internal lines of the tree diagrams of massive theory have no singularities in mass. The transition to zero mass in these diagrams is briefly discussed. (auth)

25487 (JINR–P2-5657) CALCULATION OF SUPERPROPAGATORS IN NONLINEAR QUANTUM FIELD THEORIES. Atakishiev, N. M.; Filippov, A. T. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1971. 18p. (In Russian). Dep. NTIS (U. S. Sales Only).

A new method of constructing the superpropagators, i.e. the Fourier transforms of the expressions of the form $\Sigma_{n=1}^{\infty} C_n [g^2 \Delta_F(x)]^n$, is suggested. The method makes it possible to derive by use of the same technique explicit analytic expressions for the superpropagators for a wide class of field theories—from strictly local up to essentially nonlocal. The essence of the method is the construction of a differential equation for the superpropagator which in general is of an infinite order. By use of the boundary condition at $p^2 = 0$ the solution of this equation is found depending on one arbitrary real parameter. Simple examples are given to illustrate the method. (auth)

25488 (JINR–P2-5662) REPRESENTATIONS OF n-POINT FUNCTIONS. Bogolyubov, N. N.; Vladimirov, V. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1971. 29p. (In Russian). Dep. NTIS (U. S. Sales Only).

The structure of the n-point functions, which are the Fourier–Laplace transforms of two tempered distributions with supports in the closed n-point future and past light cones and which coincide in the Jost points, is investigated. In particular, for one-point functions a new proof of the representation is constructed. (auth)

25489 (NYO–3829-58) CAUSALITY PROBLEMS AND INDEFINITE METRIC OF QUANTIZED FIELDS. Schroer, B. (Pittsburgh Univ., Pa. Dept. of Physics). Sep 1970. Contract AT-(30-1)-3829. 23p. (CONF-700710-3). Dep. NTIS.

From Conference on special topics in quantum field theory; St. Louis, Mo. (27 Jul 1970).

A brief survey of causality problems and the indefinite metric in quantum field theory is presented. Some of the concepts are explained, and some theorems are stated. (J.F.P.)

25490 FEYNMAN FUNCTIONAL INTEGRALS FOR SYSTEMS OF INDISTINGUISHABLE PARTICLES. Laidlaw, Michael G. G.; DeWitt, Cecile Morette (Univ. of North Carolina, Chapel Hill). Phys. Rev., D; 3: 1375-8(15 Mar 1971).

The theory of path integration is extended to include systems whose configuration space is multiply connected, and it is seen that there are as many distinct propagators as there are scalar representations of the associated fundamental group. It is shown that the configuration space for a system of indistinguishable particles is multiply connected. There are only two propagators for this system, giving bosons and fermions, and showing that the Feynman formalism excludes parastatistics. (auth)

25491 FAMILIES OF INDEFINITELY RISING TRAJECTORIES AND GELL-MANN'S PROGRAM. Casalbuoni, R. (Univ., Padua, Italy); Gatto, R.; Longhi, G. Phys. Rev., D; 3: 1499-1513(15 Mar 1971).

Infinite-component wave equations giving rise to a linear mass spectrum and to families of parallel linear trajectories are considered. A general discussion is given of invariant equations for wave functions belonging to SL(2,C) representations and the mass spectra that arise are examined. The simplest possibility corresponds to a higher-derivative equation that gives a linearly rising timelike spectrum that is free of continuum spacelike solutions. Discrete spacelike solutions are absent for the simplest choices of the SL(2,C) representation. The currents and the commutators among the current components are calculated by setting up for the higher-derivative equation a Lagrangian formalism and a quantization procedure based on the action principle. An explicitly factorized model is considered, with respect to the internal symmetry group, and possible nonfactorized extensions are examined. A typical feature of the current commutators is the appearance of Schwinger terms which, besides satisfying known general requirements, also appear in commutators between time components of currents. An alternative interpretation of the physical system in terms of a bound-state equation is presented. The interpretation, in terms of a bound system in two space dimensions, leads to an extension to three space dimensions, again formulable as an infinite-component wave equation. The system describes a family of parallel linearly rising trajectories spaced by one unit of angular momentum. No continuum spacelike spectrum is present, and discrete spacelike solutions are absent for physical choices of the representation of the internal spin group. (auth)

25492 RECENT PROGRESS IN CONSTRUCTING FINITE, RELATIVISTIC, AND UNITARY FIELD THEORIES. Lee, T. D. Comments Nucl. Particle Phys.; 4: 189-92(Nov-Dec 1970).

New developments in constructing relativistic quantum field theories that are free from divergence difficulties and satisfy the unitarity condition are reviewed. It is shown for the case of electromagnetic interactions how the Feynman regulator can be used to remove divergences without unitarity violation. It is noted that similar considerations can be extended to weak and strong interactions. The question of how to perform actual calculations is considered. (L.B.S.)

25493 LIE ALGEBRAIC STRUCTURE OF A NEW FIELD QUANTIZATION. Kademova, K. V.; Kraev, M. M. (Inst. of Physics, Sofia). Phys. Lett.; 34B: 405-6(15 Mar 1971).

It is shown that a new field quantization algebra with 2n generators is isomorphic to the O(2n,1) algebra. The SL(2,C) algebra is realized by the new quantization algebra with two generators only (n = 1). (auth)

25494 NONPOLYNOMIAL LAGRANGIANS: A CRITIQUE. Lee, Benjamin W. Comments Nucl. Particle Phys.; 4: 198-205(Nov-Dec 1970).

In a critical review on the subject of nonpolynomial Lagrangians the following points are emphasized: (i) Nonpolynomial Lagrangians of physical interest arise from specific physical requirements (such as symmetry). In all cases that have been considered, no partial sum of perturbation series to which the Efimov method can be applied seems to respect these requirements. (ii) To write down a nonpolynomial Lagrangian not guided by such a requirement seems to lack in motivation. Whether higher order terms in the major coupling constant are less divergent than the corresponding terms in a polynomial Lagrangian does not seem to be known. (iii) In quantizing a nonpolynomial Lagrangian with derivative coupling it is necessary for consistency to adhere to the canonical quantization procedure. (L.B.S.)

25495 RELATIVISTIC KEPLER PROBLEM. Fronsdal, Christian (Univ. of California, Los Angeles). Phys. Rev., D; 3: 1299-1302(15 Mar 1971).

Relativistic quantum field theory is used as a starting point to construct a classical, completely relativistic theory of planetary orbits. (auth)

25496 FORMAL RESTRICTIONS ON SCHWINGER TERMS IN COMMUTATORS CONTAINING J_μ AND/OR $\Theta_{\mu\nu}$. Levin, David N. (Harvard Univ., Cambridge, Mass.). Phys. Rev., D; 3: 1320-6 (15 Mar 1971).

The minimally coupled electromagnetic current J_μ and the symmetric energy-momentum tensor $\Theta_{\mu\nu}$ of the strong interactions are written as the sources of the electromagnetic and gravitational fields, respectively. In a formal sense the canonical commutators for these fields restrict the Schwinger terms in commutators containing J_μ and/or $\Theta_{\mu\nu}$. The model-independent results are ($x^0 = 0$): $S_T(n \geq 2)[J_\mu(x), J_\nu(0)] = 0$, $S_T(n \geq 4)[\Theta_{\mu\lambda}(x), \Theta_{\rho\lambda}(0)] = 0$, where $S_T(n)$ denotes the nth-order Schwinger term (term with the nth derivative of a δ function). In addition, in low-spin models it can be shown that (for spin ≤ 1) $S_T(n \geq 4) \times [J_\lambda(x), \Theta_{\mu\nu}(0)] = 0$, and that (for spin $\leq \frac{1}{2}$) $S_T(n \geq 3)[J_\lambda(x), \Theta_{\mu\nu}(0)] = 0$. These conditions apply when $\Theta_{\mu\nu}$ is defined in the usual way or in the manner prescribed by Callan, Coleman, and Jackiw. Stronger conditions can be derived for a more narrowly defined $\Theta_{\mu\nu}$ and for models with restricted forms of interactions. The formal significance of these results is discussed. (auth)

25497 NONPOLYNOMIAL LAGRANGIANS WITH DERIVATIVE INTERACTIONS. Hunt, A. P.; Koller, K.; Shafi, Q. (Imperial Coll. of Science and Tech., London). Phys. Rev., D; 3: 1327-34 (15 Mar 1971).

The techniques for computing S-matrix elements for nonpolynomial scalar-field Lagrangians with derivative interactions are presented. To second order in the interaction Lagrangian, it is shown that all the dependence arising from the derivative part is completely separated out as operators acting on integrals identical to those obtained in a nonderivative theory. The Fourier transforms of self-energy graphs for a class of nonlocal interaction Lagrangians are taken in the massless case. The on-mass-shell contributions are determined by the analytic continuation of the coefficients appearing in the series expansion of the Lagrangian. As special examples, two Lagrangians which are isoscalar analogs of chiral SU(2) × SU(2) Lagrangians are treated. The possible equivalence of on-mass-shell matrix elements for Lagrangians related by nonlinear field transformations is discussed. (auth)

25498 SOLUTION OF A RELATIVISTIC BETHE-SALPETER EQUATION IN THE WHOLE s PLANE. zur Linden, E. (Max-Planck Institut fuer Physik und Astrophysik, Munich). Phys. Rev., D; 3: 1335-43(15 Mar 1971).

Using an appropriate conformal mapping of the cut s plane into a unit circle, expansions of the solutions of the homogeneous and inhomogeneous Bethe–Salpeter equation in the Wick–Cutkosky model are found, which converge for arbitrary complex s. Besides an extensive investigation of special features of the model, such as the behavior of Regge trajectories in the whole energy range and the high-energy behavior in the direct channel, some conclusions are drawn on important properties of more general cases, and the difference from the nonrelativistic case and the influence of those inelasticities which are already incorporated in the ladder approximation are analyzed. (auth)

25499 REMARKS ON THE DIPOLE-GHOST SCATTERING STATES. Nakanishi, Noboru (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., D; 3: 1343-7(15 Mar 1971).

By using Nagy's modified Lee model, it is explicitly shown that the dipole-ghost scattering states exist and can be expressed as superpositions of the eigenstates of the Hamiltonian. Thus, the Ascoli–Minardi theorem, which guarantees the unitarity of the physical S matrix, ceases to be valid in dipole-ghost theories. (auth)

25500 HIGHER-ORDER RADIATIVE CORRECTIONS TO EIKONAL FUNCTIONS IN MASSIVE ELECTRODYNAMICS AT VERY HIGH ENERGY. Yao, York-peng (Univ. of Michigan, Ann Arbor). Phys. Rev., D; 3: 1364-74(15 Mar 1971).

It is shown that the assumptions of an impact-parameter representation and energy-independent $d\sigma/dt$ for fermion–fermion scattering at high energy imply that the amplitude is proportional to square of the vector form factors, multiplied by the bare eikonal functions, to all orders in radiative corrections without vacuum polarization. This is done in the framework of massive electrodynamics. It is explicitly demonstrated that these two assumptions are satisfied for some sets of graphs in the two-photon exchanged amplitude with fourth-order radiative correction, where the radiative particle is taken to be a pseudoscalar in order to simplify the algebra. (auth)

25501 QUANTUM ELECTRODYNAMICS IN AN ANALYTIC REPRESENTATION. Saraswati, D. K. (London Univ. (Notre Dame Univ., Nelson, Can.). J. Phys., A (London); 4: 165-83 (Mar 1971).

The analytic representation of quantum field theory suggested previously is further investigated, by working out its details for quantum electrodynamics. The coupled equations for Green's functions are discussed and the lowest order contributions to Compton and Møller scatterings are calculated. Through the Fourier transforms, the expressions show close agreement with the results of the conventional approach. A nonlocal modification of the interaction kernel is studied. This leads to finite self-energy, vacuum polarization and vertex operator expressions, and in the limit, to a simple regularization of quantum electrodynamics. (auth) (UK)

25502 FRAME OF REFERENCE IN RELATIVISTIC THEORIES. Dehnen, H. (Univ., Freiburg i. B.). Int. J. Theor. Phys.; 3: 509-11(Dec 1970).

The usual identification of the physical frame of reference with a special coordinate system is not satisfactory for several reasons. The most important one is that in this case the observable quantities of every relativistic theory can not be given in a general covariant manner with regard to any substitution of the space-time coordinates x^μ. But this is necessary in the framework of a general theory of measurements, which should be free from any coordinate effects. In doing this, it is not allowed to connect the frame of reference with a special coordinate system. Therefore, the frame of reference in a general covariant way is defined. (auth) (UK)

25503 QUANTIZATION OF SPACE–TIME AND GENERALIZATION OF THE DIRAC EQUATION. Meessen, A. (Univ. Catholique, Louvain, Belgium). Ann. Soc. Sci. Brux. Ser. I: 84: 267-75(30 Dec 1970). (In French).

Instead of assuming a priori that one should be able to measure space and time intervals of arbitrarily small size, it seems more reasonable to introduce the concept of an ultimate limit for the smallest measurable distance, whose value (a) is left unspecified. This leads, however, to a generalization of relativistic quantum mechanics, since one has now to consider three universal constants: c, h, and a. One has actually to consider a lattice for the possible eigenvalues of the space-time coordinates (x, y, z, ct) and to replace the usual differential field equations by finite difference equations. Such a generalization of the Gordon–Klein equation leads to new aspects when the particle energy tends towards hc/a, as was shown previously. But this second order finite difference equation is also equivalent to a set of first order finite difference equations, which correspond to a generalization of the usual Dirac equations. It appears, however, that one has to introduce spinors of rank eight, at least, and that this is an expression of the internal degrees of freedom which are associated with spin, charge and a distinction between left and right. (auth)

25504 CLASS OF COVARIANT COMMUTATORS FOR FIELDS OF INTEGER SPIN J AND $m \neq 0$, AND FOR $m = 0$ WITHOUT THE NECESSITY OF INTRODUCING AN INDEFINITE METRIC. Weder, R.; Zandron, O. (Univ., Buenos Aires). Nuovo Cim.; 2A: 455-66(21 Mar 1971).

It is shown that it is possible to give covariant commutators for a field of integer spin J, for nonzero and for zero mass, as particular cases of a more general commutator. This is explicitly for spin 1 and 2. The decompositions of the momentum amplitude for a field of integer spin J are generated by decomposing the momentum amplitude of a vector field A_μ in three directions in such a way that the condition of zero divergence is satisfied. In the nonzero-mass case, as is well known, quantum conditions are given on the $(2J + 1)$ independent components; in this way the usual commutators are obtained. In the massless case only two of the components appear as gauge invariants, and for this reason quantum conditions are given only on these two components, since the

others are physically irrelevant. Moreover, the commutators thus obtained are compatible with the field equations and with the subsidiary conditions, and the energy is automatically positive definite, without it being necessary to introduce an indefinite metric. (auth)

25505 CONSERVATION OF THE AXIAL CURRENT IN MASSLESS ELECTRODYNAMICS. Dolgov, A. D.; Zakharov, V. I. (Inst. for Theoretical and Experimental Physics, Moscow). Nucl. Phys.; B27: 525-40(1971).

Conservation of the axial current in massless electrodynamics is considered in connection with the existence of the so-called anomalous terms in the equation for the divergence of the axial current. It is shown that in the limit of vanishing electron mass m transitions forbidden by γ_5 invariance give a non-vanishing contribution to the imaginary part of the triangle graph. This phenomenon is analogous in some respect to the breaking of the formal consequences from γ_5 invariance for the probability of the transition between electrons with right and left helicity through the emission of a photon. As was noticed by Lee and Nauenberg, this probability does not vanish in the limit of m = 0. In this respect the appearance of an ultraviolet divergence in the triangle graph is irrelevant to the breaking of γ_5 invariance. Some examples are given of well defined loop graphs and tree graphs which nevertheless violate conservation of the axial current at m = 0 for some particular configuration of external momenta. Also another limiting procedure is considered when m is chosen to be equal to zero from the very beginning but the photon mass is chosen to be finite. It then becomes possible to construct a conserved axial current but the matrix element associated with the triangle graph proves to be singular in the photon mass. In the case of m = 0 a recipe to calculate the triangle graph is given which implies the validity of the divergence equation without any anomalous term. However, the matrix element of the pseudoscalar density j^5 is singular in m in this case. (auth)

25506 OPERATOR PRODUCT EXPANSIONS NEAR THE LIGHT CONE. Brandt, Richard A. (CERN, Geneva. Univ. of Maryland, College Park); Preparata, Giuliano. Nucl. Phys.; B27: 541-67(1971).

The behavior of products A(x)B(0) of local field operators near the light cone $x^2 = 0$ is studied in renormalized perturbation theory. Operator product expansions are shown to exist and describe this behavior in each order. This result is an extensive generalization of known results about short distance ($x^\mu \to 0$) behavior in quantum field theory. Similar expansions are derived for the product $j_\mu(x)j_\nu(0)$ of vector currents and for other interesting products in φ^4 theory, the gluon model, all other renormalizable models, and in soluble field theoretic models. Properties of the expansions are discussed in detail. The usefulness of such expansions arises from the fact that they describe, for example, the configuration space limit corresponding to the physical momentum space limit in which a very massive current interacts with a hadronic system in a high energy inelastic collision. The operator expansions predict the strength of the light cone singularities and thereby provide a means of measuring the dimensions of interacting fields, they determine properties of amplitudes in several variables, and they provide relations between form factors describing different experiments corresponding to different matrix elements of the current products. Several such applications are described and it is concluded that the present experimental results are in good agreement with the naive field dimensions and canonical singularity structure of renormalizable field theories. (auth)

25507 SYMMETRY OF THE DIRAC EQUATION. Smirnov, A. D. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 11: 614-17 (Nov-Dec 1970). (In Russian).

The symmetry of Dirac's free equation was studied and it was found that in addition to the known symmetry the equation holds a hidden O(3) symmetry. (tr-auth)

25508 OBSERVER THEORIES BASED ON STUECKELBERG EQUATIONS OF MOTION. Cawley Robert G. (Naval Ordnance Lab., Silver Spring, Md.). Int. J. Theor. Phys.; 3: 483-505(Dec 1970).

Stueckelberg dynamics is regarded as providing a basis for the construction of observer centered theories of particle motions. The approach involves the use of a generalized Jacobi principle to replace the four-dimensional dynamical theory of Stueckelberg by a four-dimensional geometrical theory, and then a three-dimensional dynamics is constructed from this. The causal difficulties encountered by Stueckelberg for curves which reverse direction in time appear to be absent in the present scheme. Some of the ideas involved in the (conventional) causal framework recently constructed to deal with causal difficulties associated with hyperlight phenomena are made more definite in a simple context. Some insight is gained into the possible roles to be played by tachyons in a particle theory and interesting results are found involving classical Lagrangian and canonical formalisms for lightlike particles. (auth) (UK)

25509 GAUGE INVARIANCE, LORENTZ COVARIANCE, AND THE OBSERVER. Marx, Egon (Drexel Univ., Philadelphia). Int. J. Theor. Phys.: 3: 467-82(Dec 1970).

A number of questions related to the role of the observer in classical and quantum theories of fields, in particular electrodynamics are discussed. The gauge-independent parts of the electromagnetic potential, which are classical observables, both in a noncovariant manner and in a Lorentz covariant, observer-dependent way are found. An analysis of the probabilistic interpretation of relativistic quantum mechanics, similar to that of the nonrelativistic theory is presented, and the gauge invariance of the corresponding probability amplitudes is discussed. (auth) (UK)

Gravitation and General Relativity

Refer also to abstract 24828.

25510 DEGREE OF SHARPNESS IN SOLUTIONS OF EINSTEIN'S FIELD EQUATIONS. Waylen, P. C. (Cambridge Univ., Eng.). Proc. Roy Soc. (London), Ser. A; 321: 397-408 (23 Feb 1971).

Einstein's theory of gravitation predicts that small changes in the gravitational field will propagate both sharply along the light cone and diffusively through its interior. The relative importance of sharp and diffusive propagation is linked to an invariant which arises in Sciama, Waylen and Gilman's Phys. Rev. 187: 1762(1969) integral formulation of Einstein's field equations. The invariant can be evaluated as an expansion in proper time, and the leading terms used to estimate the extent of diffusion. It is shown that, on a general empty space-time, the onset of diffusion is governed by a scalar related to the Bel–Robinson tensor. For some weak fields and all null fields this scalar may be equated to the covariant d'Alembertian of a gravitational density. On flat and plane wave space-times this quantity vanishes and the field equations satisfy a Huygens principle. (auth) (UK)

25511 EXPERIMENTAL TEST OF SYMMETRY OF GRAVITATIONAL RADIATION. Weber, J. (Univ. of Maryland, College Park). Phys. Lett.; 34A: 271-3(22 Mar 1971).

Preliminary results are presented on an experiment to observe the symmetry of gravitational radiation. Coincidence experiments were carried out between a disc and a cylindrical gravitational radiation antenna, and between two cylindrical antennas. Observations find no evidence for a scalar component. The observed symmetry is that of Einstein's pure tensor field. (auth)

25512 QUANTUM FALLING CHARGES. Wesley, Walter Glen. Chapel Hill, N. C.; Univ. of North Carolina (1970). 85p. University Microfilms Order No. 71-3613.

Thesis.

The interaction of a scalar meson with an external gravitational field giving rise to a photon is studied for the purpose of comparing the results with those obtained by solving the classical equation of motion for the radiation due to a falling charge. Transition amplitudes for the relevant Feynman diagrams are calculated by the action method, and the differential cross section for the process is calculated assuming that the incoming meson has little energy. The low-energy results agree very well with the results obtained in the classical case. The differential cross section contains an infrared divergence and in order to cancel this out one must consider the radiative corrections to the elastic scattering of a meson by an external gravitation field. As expected the infrared divergence in these radiative corrections cancels out the infrared divergence occurring in the inelastic scattering process. With the radiative correction amplitudes available one can also consider the renormalization problem, as these amplitudes contain quadratically divergent integrals. The ordinary cut-off method for evaluting these integrals, which is used in quantum electrodynamics, does not seem to work in this case. In order to handle quadratic divergences it appears that one must use the full formalism of regulators and that it will require the use of two regulators. (Diss. Abstr. Int., B)

25513 INVARIANCE AND CONSERVATION. Cattaneo, Carlo (Univ., Rome). Rend. Semin. Mat. Fis. Milano; 39: 196-222(1969). (In Italian).

From Symposium in Honor of Giuseppe Occhialini on the 20th Anniversary of His Return to Italy, Milan, Italy. See CONF-681083.

The method of infinitesimal transformations in order to deduce conservation laws from suitable hypotheses of invariance of the

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field equations is here critically discussed. The range of validity of the method is specified. The reasons for which the procedure becomes partially illusory in the Einstein's gravitational theory are then made precise. (auth)

25514 LORENTZ AND GAUGE INVARIANCE, CANONICAL QUANTIZATION, AND PION–GRAVITON SCATTERING. Russo, M. J. (Northeastern Univ., Boston); Arnowitt, R. Phys. Rev., D; 3: 1283-91(15 Mar(1971).

Lowest-order pion-graviton scattering is calculated using the canonical quantization of general relativity. The process is examined in order to investigate if the canonical quantization produces Lorentz-invariant and gauge-invariant S-matrix elements, and also if the S matrix is invariant under a specific class of q-number coordinate transformations. While the classical theory automatically possesses the above invariances, they are seen not to be a priori guaranteed in the quantum theory. The S-matrix elements calculated, however, correctly possess the above invariances. (auth)

25515 GEOMETRICAL ASPECTS OF THE TWO-COMPONENT NEUTRINO FIELD IN GENERAL RELATIVITY. Griffiths, J. B.; Newing, R. A. (University Coll. of North Wales, Bangor). J. Phys., A (London); 4: 208-13(Mar 1971).

Conditions for the existence of a neutrino field are expressed in terms of spin coefficients. It is shown that a neutrino-gravitational field with positive energy density necessarily defines a null geodesic congruence. The structure of the Ricci tensor is examined and shown to be closely related to the twist and shear of the congruence. (auth) (UK)

25516 THEOREM ON THE LOCAL ISOMETRIC EMBEDDING OF EMPTY SPACE–TIMES IN A SPACE OF CONSTANT CURVATURE. Collinson, C. D. (Univ. of Hull, Eng.). J. Phys., A (London); 4: 206-7(Mar 1971).

It is shown that no nonflat empty space–time can be embedded locally and isometrically in a five-dimensional space of nonzero constant curvature. (auth) (UK)

25517 PRECISE SOLUTION OF A SYSTEM OF EINSTEIN'S EQUATIONS. Bocharova, N. M.; Bronnikov, K. A.; Mel'nikov, V. N. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 11: 706-9 (Nov-Dec 1970). (In Russian).

A centrally symmetric statistical self-consistent problem of scalar and gravitational field interactions was resolved. In contrast to the published data for scalar field, the equation $(\Box + m^2 + (R/6)\varphi = 0)$ was used where $\Box = \nabla^\alpha\nabla_\alpha$ is the general covariant d'Alembert operator, R is the scalar curvature. The equation is conformally invariant at m = 0 and permitted correct quasi-classical transformation. The studies were limited to a mass-free scalar field. (R.V.J.)

25518 EINSTEIN–MAXWELL NULL FIELDS WITH A NULL CURRENT DISTRIBUTION. Goodinson, P. A. (Queen Elizabeth Coll., London); Newing, R. A. Int. J. Theor. Phys.; 3: 429-35 (Dec 1970).

Null Einstein–Maxwell charge-free fields such that the propagation vector is a scalar multiple of a gradient are not determined uniquely by the geometry of the space-time. The metric for space-times admitting such exceptional fields can always be transformed to the Wyman–Trollope form. This same result follows if there is a nonvanishing null current density associated with the field. (auth) (UK)

25519 NEUTRINO RADIATION FIELDS IN GENERAL RELATIVITY. Griffiths, J. B.; Newing, R. A. (University Coll. of North Wales, Bangor). J. Phys., A (London); 4: 306-8(Mar 1971).

It is shown that there exist Einstein–neutrino fields which are not defined uniquely by the metric of space–time. These fields form a subclass of the neutrino pure radiation fields and are analogous to a previous exceptional case for Einstein–Maxwell null fields. (auth) (UK)

Scattering Theory

Refer also to abstracts 25356 and 25807.

25520 (IFVE-STF-70-18) A SIMPLE DERIVATION OF THE KINOSHITA–LOEFFEL–MARTIN BOUND. Ezhela, V. V.; Stroganov, Yu. G. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1970. 12p. (In Russian). NTIS (U. S. Sales Only).

The simple derivation of the upper bound for the scattering amplitude at angles not equal to 0 and π is given. The dependence of results on the analyticity region is considered. It is shown that even at the assumption of the analyticity in the whole cut plane z, the factor $\sin^{-2}\Theta$ in the Kinoshita–Loeffel–Martin bound cannot be replaced by $\sin^{\alpha-2}\Theta$, $a > 0$. (auth)

25521 (ITF-70-76-P) RIEMANN'S METHOD IN THE INVERSE PROBLEM OF THE SCATTERING THEORY. [PART] II. Gugushwili, H. I.; Mentkovskii, Yu. L. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1970. 10p. (In Russian). Dep. NTIS (U. S. Sales Only).

The estimates of the Riemann's function and the κ-function obtained previously are improved and the method of their obtaining is generalized for the case of arbitrary angular momentum l. (auth)

25522 (JINR-P2-5577) EIKONAL SCATTERING AMPLITUDE IN SOME MODELS OF FIELD THEORY AT HIGH ENERGIES. Barbashov, B. M.; Nesterenko, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1971. 25p. (In Russian). Dep. NTIS (U. S. Sales Only).

High-energy scattering of particles in some models of field theory is considered as well as the possibility of the amplitude representation in the eikonal form. (auth)

25523 (OU-LNS-71-1) UNITARITY, FACTORIZATION THEOREM AND REMOVAL OF LEVEL DEGENERACY IN DUAL RESONANCE MODEL Kawati, Syozi; Konisi, Gaku; Saito, Takesi; Tanaka, Azuma (Osaka Univ. (Japan). Lab. of Nuclear Studies). Feb 1971. 9p. Dep. NTIS (U. S. Sales Only).

It is shown that by using a unitarity relation for many-body scattering amplitude a Regge residue appearing in this amplitude is factorized. This theorem is a generalization of that in the two-body case. According to this theorem the famous level degeneracy in dual resonance models is expected to be removed if unitarity is taken into account. An equation is proposed for removing the degeneracy, which has a strong resemblance to that in the quantum mechanical perturbation theory with degenerate levels. (auth)

25524 (PAM-70-9) RATIONAL APPROXIMATIONS AND PHENOMENOLOGICAL MODELS. Benayoun, M.; Leruste, Ph. (College de France, Paris. Laboratoire de Physique Atomique et Moleculaire). Dec 1970. 21p. (In French). Dep. NTIS (U. S. Sales Only).

An analysis was made of phenomenological models associated with the Breit–Wigner formulas and the effective range theory of Ross and Shaw. An undefined wave and a class of weight functions are considered. It is proved that in general these models are rational approximations of the D/D formalism and irreducible with respect to one another. The D/D formalism is expressed for the undefined wave, and the degree law of the $B_\lambda(s)$-functions and the zerology of D are determined. (France)

25525 DUAL LOOP TERMS AND COUNTERTERMS BY MEANS OF THEIR PROJECTIVE GROUP. Fenster, S. (Argonne National Lab., Ill.); Karpf, A. D. Phys. Lett.; 34B: 412-18 (15 Mar 1971).

A unified treatment of dual loop term and counterterm by means of their projective group is presented for the one loop case. The significance of parameters in this method of linear differential equations is discussed for multiloop terms. (auth)

25526 BEHAVIOR OF FORM FACTORS AND SCATTERING AMPLITUDES FROM ANALYTICITY AND OTHER CONSTRAINTS. Narayan, D. S. (Univ. of Maryland, College Park). Phys. Rev., D; 3: 1439-46(15 Mar 1971).

From the singularity structure of a form factor G(t) and that of the imaginary part F(s,t) of a scattering amplitude, in the t plane, and from certain assumptions on their growth outside the physical region, representations of G(t) and F(s,t) are obtained from which an asymptotic form of these functions is deduced. It is shown that the imaginary part of the scattering amplitude for identical particles has the same analytical structure in the P_t^2 plane (square of the transverse momentum) as G(t) in the t plane, and they have the same asymptotic behavior in the variables P_t^2 and t, respectively. For the former case, an exact representation of ln F(s,t) is obtained as a power series in trigonometric functions with coefficients which are functions of s. These coefficients can, in principle, be determined from experiment by a procedure similar to that employed in partial-wave analysis. It is argued that a few terms in this series would suffice for a parametrization of the scattering amplitude at all angles and energies. The representations of G(t) and F(s,t) are also used to obtain asymptotic lower bounds on the form factors and the scattering amplitudes similar to those previously obtained by Martin. For the scattering amplitude, bounds are obtained separately for identical and nonidentical particles, and in the latter case the bound is well behaved at $\theta = 90°$, unlike that of Martin. (auth)

25527 ASYMPTOTICS OF PARTIAL WAVES IN REGGE THEORY AND CONSTRAINTS ON PARTIAL-WAVE SUBTRACTION CONSTANTS. Bart, G. R. (Chicago City Coll.); Warnock, R. L. Phys. Rev., D; 3: 1429-38(15 Mar 1971).

In a Regge theory of spinless elastic scattering, subtraction constants in physical partial waves are not always free parameters. In a partial wave where there is no Castillejo–Dalitz–Dyson (CDD) pole, the subtraction constant $A_l(s_0)$, $s_0 < 4m^2$, is uniquely determined when the left-cut term and the elasticity η_l are specified. If there are CDD poles, all at finite points, then the subtraction constant is again fixed uniquely, but its value depends on the CDD parameters. If there is a CDD pole at infinity, the subtraction constant is unconstrained. These results are proved assuming that high-energy behavior is determined by a moving Pomeranchuk pole, with or without associated branch points. The analysis, although model independent, has implications for a dynamical model based on Reggeon exchange —namely, a model in which the input to the inelastic N/D equation (left- and right-cut parts) is constructed from crossed-channel Regge terms. In such a model the N/D equation is a regular Fredholm equation without high-energy truncation. In general, the phase shift obtained as output from the N/D equation has a high-energy behavior required by Regge theory if, and only if, the subtraction-constant constraint is satisfied. It is argued that new calculations are needed to test the Reggeon-exchange model. Earlier calculations in the Chew–Jones scheme are not conclusive for the formulation given. (auth)

25528 EXPONENTIAL REPRESENTATION FOR SCATTERING AMPLITUDES. Chew, H. (Clarkson Coll. of Tech., Potsdam, N. Y.). Phys. Rev., D; 3: 1458-61(15 Mar 1971).

A representation of scattering amplitudes as Laplace transforms in the momentum transfer is described. The representation is motivated by the observed (approximate) exponential decrease with increasing $|t|$, for small t, of differential scattering cross sections at high energies. Applications to some scattering problems are discussed. The resulting expressions tend to be simpler than those one obtains with the Fourier–Bessel transform. (auth)

25529 AMATI–BERTOCCHI–FUBINI–STANGHELLINI–TONIN EQUATION AND COMPLEX REGGE POLES. Misheloff, Michael N. (Univ. of California, Berkeley. Princeton Univ., N. J.). Contracts W-7405-eng-48; AF49(638)1545. Phys. Rev., D; 3: 1486-91(15 Mar 1971).

The J-plane singularity structure of the solution of an Amati–Bertocchi–Fubini–Stanghellini–Tonin (ABFST) equation is explored numerically. One real pole and two complex conjugate pairs of poles are found in the region $\mathrm{Re}J > -2$. The values of the imaginary parts of the complex-pole positions depend only on the multiparticle amplitude in the region of extremely small momentum transfer between links ($-t \lesssim m_\pi^2$). This result arises from the fact that the dependence of the diagonalized ABFST equation on the small-momentum-transfer region is strongly enhanced for $\mathrm{Re}J < 0$. The residues of first pair of complex poles and the real pole are determined. The dependence of the pole positions and residues on the coupling constant is discussed. (auth)

25530 HIGH-ENERGY SCATTERING. II. Low, F. E. Comments Nucl. Particle Phys.; 4: 193-7(Nov-Dec 1970).

A summary is given of the known mechanisms that give rise to the different types of J-plane singularities. Regge poles, cuts, fixed poles, and Kronecker deltas are discussed. (L.B.S.)

25531 PHENOMENOLOGICAL APPLICATIONS OF 6-POINT FUNCTIONS FOR MESONS WITH PHYSICAL TRAJECTORIES. Uschersohn, I. (Weizmann Inst. of Science, Rehovot, Israel). Lett. Nuovo Cim.; 1: 371-7(27 Feb 1971).

Using previous Veneziano model 6-point functions the amplitudes and widths are found for the decays $\rho \to 2\pi$, $f^0 \to 2\pi$, $\sigma \to 2\pi$, $A_1 \to 3\pi$, $A_1 \to \rho + \pi$, $A_1 \to \sigma + \pi$, $H \to \rho + \pi$, $\omega \to 3\pi$, $A_2 \to 3\pi$, and $A_2 \to \rho + \pi$. (J.F.P.)

25532 REGGE-EIKONAL FORMALISM IN THE VAN HOVE MODEL. Torgerson, R. (Ohio State Univ., Columbus. Stanford Univ., Calif.). Lett. Nuovo Cim.; 1: 378-83(27 Feb 1971).

Diffraction scattering is studied. Using new techniques the additivity of the eikonal χ and the closely related Sopkovitch prescription are considered. For this purpose it is found that the Van Hove model of Regge poles can be used. (J.F.P.)

25533 S-MATRIX INTERPRETATION OF QUANTUM THEORY. Stapp, Henry Pierce (Univ. of California, Berkeley). Phys. Rev., D; 3: 1303-20(15 Mar 1971).

The usual interpretation of quantum theory is clouded by the following points. (1) Invalid classical concepts are ascribed fundamental status. (2) The process of measurement is not describable within the framework of the theory. (3) The subject-object distinction is blurred. (4) The observed system is required to be isolated in order to be defined, yet interacting in order to be observed. These problems are resolved in a straightforward way by the unequivocal acceptance of a thoroughly pragmatic S-matrix viewpoint. This interpretation is described, and it is explained how and why the full physical content of quantum theory resides in the S matrix. (auth)

25534 PARAMETRIZATION OF SCATTERING AMPLITUDES: DEFINITION OF CROSSING SYMMETRIC MEASURE AND INERTIAL TENSOR. Eriksson, Karl-Erik (Inst. of Theoretical Physics, Goeteborg). Phys. Scr.; 1: 224-30(1970).

The parametrization of N-point functions and scattering amplitudes in a relativistic particle theory is briefly discussed. A "democratic" parametrization is suggested. In connection with this a 4-dimensional "tensor of inertia" is defined in close connection to the gram matrix. A measure is introduced in the (nonphysical) Euclidean part of momentum space. (auth) (Sweden)

25535 KINEMATIC SINGULARITIES OF TRANSVERSITY AMPLITUDES. Johannesson, Nils (Univ., Lund, Sweden). Phys. Scr.; 1: 231-2(1970).

A method given by Trueman for obtaining the kinematic singularities of helicity amplitudes is applied to the transversity amplitudes introduced by Kotanski. The results are in agreement with those found by other methods. In two cases, viz., the physical boundary singularities and the $s = 0$ singularities for equal incoming and outgoing masses, more explicit formulas are worked out. (auth) (Sweden)

25536 SCATTERING AND CURRENT OPERATORS. Enflo, B. O.; Laurent, B. E. (Univ., Stockholm). Phys. Scr.; 2: 88-93(1970).

The scattering amplitude on the mass shell is used to construct a "coarsened current operator" which has many properties in common with the conventional field-theoretical current. The properties investigated here are: asymptotic additivity, charge conservation, transformation property under the S-operator as well as under C, P and T. The operator mentioned is defined for weak and electromagnetic interactions and may serve the same purpose as the current operator. This is indicated in a derivation of the Adler–Weisberger sum rule. (auth) (Sweden)

25537 UNITARY AND SEPARABLE APPROXIMATIONS TO THE TWO-PARTICLE TRANSITION AMPLITUDE. Karlsson, Bengt R. (Inst. of Theoretical Physics, Goeteborg). Phys. Scr.; 2: 94-5(1970).

Unitary and separable approximations to the two-particle transition amplitude are constructed in such a way that the region of good agreement with the exact amplitude can be chosen with some freedom. The origin of nonphysical poles in such approximation is discussed and it is indicated how they can be avoided. (auth) (Sweden)

25538 TACHYON-FREE DUAL MODEL WITH A POSITIVE-INTERCEPT TRAJECTORY. Neveu, A.; Schwarz, J. H. (Princeton Univ., N. J.). Phys. Lett.; 34B: 517-18(29 Mar 1971).

A dual-resonance model with two kinds of trajectories split by one-half unit is constructed. The lowest mass state on the leading trajectory has spin one, although the G-parity assignments are unsuitable for an identification with π's and ρ's. (auth)

25539 POMERON FORM FACTORS AND DUAL REGGE CUTS. Lovelace, C. (Rutgers–The State Univ., New Brunswick, N. J.). Phys. Lett.; 34B: 500-6(29 Mar 1971).

By factorizing dual loops, amplitudes with external pomerons are obtained. All Regge cuts formed from pomerons and leading reggeons are also extracted. They obey Gribov's reggeon calculus, with specific propagators and vertices. The pomeron–reggeon cut converges to the weak absorption model as $s \to \infty$. (auth)

25540 PRESENT STATE OF RIGOROUS ANALYTIC PROPERTIES OF SCATTERING AMPLITUDES. Sommer, Gustav (Univ., Karlsruhe, Ger.). Fortschr. Phys.; 18: 577-688(1970).

The main (old and new) results about analyticity properties of two-body transition amplitudes deducible from general local field theory are reviewed. Most of the proofs are included as well as applications. (auth)

25541 HIGH-ENERGY LIMITS OF FEYNMAN-LIKE DIAGRAMS WITH VENEZIANO AMPLITUDES. Kaiser, H. J.; Kaschluhn, F.; Wieczorek, E. (Institut fuer Hochenergiephysik, Berlin. Humboldt Univ., Berlin). Nucl. Phys.; B27: 633-40 (1971).

A generalized box diagram is studied where the Feynman propagators in the t-channel are replaced by Veneziano amplitudes. It is shown that the high-energy limit depends on the direction in which s tends to infinity in the complex plane. Moreover, an unexpected dependence on the intercept of the input trajectory is ob-

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tained. Therefore, the usual procedure to derive in off-mass-shell theories the high-energy behavior and the singularity structure in the j-plane from the asymptotic properties at $s \to -\infty$ is not justified in general. (auth)

25542 UPPER AND LOWER BOUNDS ON GENERALIZED SCATTERING LENGTHS. Arthurs, A. M.; Coles, C. W. (Univ. of York, Eng.). J. Phys., A (London); 4: 298-305(Mar 1971).

Upper and lower bounds on generalized scattering lengths for static potentials are presented. Their derivation is based on complementary variational principles for a certain class of linear operator equations. Generalized forms of the well-known bounds of Schwinger and of Spruch and Rosenberg are obtained from this approach together with related complementary bounds which are new. The results are illustrated with calculations for screened Coulomb potentials. (auth) (UK)

25543 EQUIVALENCE THEOREM FOR S-MATRIX ELEMENTS. Keck, B. W.; Taylor, J. G. (Univ. of Southampton, Eng.). J. Phys., A (London); 4: 291-7(Mar 1971).

It is attempted to prove the equivalence theorem for S-matrix elements. It is distinguished between the dynamical aspect — which ensures that the dynamics is coordinate-independent, and requires care in preservation of the order of noncommuting operators — and the kinematical aspect, which ensures that asymptotic fields are unchanged. It is the latter condition which causes difficulty; whilst trivial for the free field nontrivial examples are given which violate it. (auth) (UK)

Particle Accelerators

Refer also to abstracts 23758, 24271, 24546, and 25705.

25544 (AECL-3779) PLANAR FORMATION OF AN ELECTRON RING IN A STATIC MAGNETIC FIELD. Lee-Whiting, G. E. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Dec 1970. 56p. Dep. NTIS (U. S. Sales Only). AECL $1.50.

Conditions are established under which a charged particle moving in the transverse symmetry plane of an axially symmetric static magnetic field will follow a spiral trajectory which approaches a circle asymptotically. An approximate expression is derived for the time interval which a particle having initial conditions slightly different from those for the spiral trajectory spends near the limiting circle. This expression is used to estimate the steady-state mean particle-density in a ring about the limiting circle resulting from the injection of a beam. In order to provide an indication of the onset of collective effects the ratio of the mean density in the ring to the density in the injected beam and the ratio of the maximum magnetic field generated by the ring to the guide field are estimated. Tolerances on the beam-defining parameters are calculated by requiring that all particles spend some time in the ring. It is concluded that for reasonable tolerances on the beam a device of this type cannot generate a ring in which the mean particle density is substantially greater than the density in the incident beam. The relationship of this work to the 1650B injector proposed by W.B. Lewis is discussed. (auth)

25545 (ANU-P-506) ACCEPTANCE CALCULATIONS FOR THE AUSTRALIAN NATIONAL UNIVERSITY MODEL EN (HVEC) TANDEM ACCELERATOR. Merrill, N. H.; Whineray, S. (Australian National Univ., Canberra. Dept. of Nuclear Physics). [1970]. 14p. Dep. NTIS (U. S. Sales Only).

The phase space acceptance of an HVEC Model EN tandem accelerator is calculated under the usual operating conditions. (auth)

25546 (BNL-15646) AGS INJECTION WITH 200-MeV LINAC. Claus, J. (Brookhaven National Lab., Upton, N. Y.). 12 Jan 1971. 27p. Dep. NTIS.

Multiturn injection in synchrotrons is considered in order to indicate conditions for which beam losses remain small. After describing the present mode of injection into the AGS at Brookhaven National Laboratory, the use of matched beams is advocated as a means to circumvent certain space-charge effects. A method for filling both the horizontal and the vertical phase space and a method for establishing tolerances for the betatron frequencies are described. It appears desirable to install quickly variable quadrupoles, to be used to compensate for the frequency shifts induced by the accumulating current in the circulating beam. At least for some cases, injection with a stepped closed orbit appears to require less aperture in the synchrotron than injection of a comparable beam with a continuously moving closed orbit. Several numerical examples applicable to the improved AGS are given. The conclusion is that 44-turn injection (limited by the available pulse length of 200 μsec of the 200-MeV linac injector) is practicable and, in view of the relationship between brightness and current of the linac beam, is to be preferred above injection of a few revolutions with a larger beam. (auth)

25547 (CERN-71-1) THE ISR BACKGROUND CONDITIONS FROM MEASUREMENTS AT THE CERN PROTON SYNCHROTRON. Agoritsas, V.; Bott-Bodenhausen, M.; Hyams, B. D.; Potter, K. M. (European Organization for Nuclear Research, Geneva (Switzerland)). 14 Jan 1971. 42p. Dep. NTIS (U. S. Sales Only).

The primary source of background radiation at the CERN Intersecting Storage Rings (ISR) will be interactions between the high-intensity stored beam and the residual gas in the vacuum vessel, even at 10^{-10} torr. Pertinent measurements made at the CERN Proton Synchrotron recently are reviewed. No intolerable background conditions at the ISR are expected. Monitoring of beam–beam interactions at the ISR with simple arrangements of scintillation counters is also discussed. (R.W.R.)

25548 (CONF-710503-4) SPECIFICATIONS FOR A MICROWAVE LINEAR ELECTRON ACCELERATOR FOR RADIOTHERAPY. (Enviro-Med, Inc., La Jolla, Calif.). 6 Aug 1969. 73p. (MPD-12).

From International symposium on RNA viruses and host genome in oncogenesis; Amsterdam, Netherlands (12 May 1971).

For Stanford Univ., Calif. Dept. of Radiology.

Performance specifications for the CRTS (Committee for Radiation Therapy Studies) electron linac for radiotherapy are presented in detail. Electron beam specifications; photon beam specifications; radiotherapy instrumentation, controls, and interlocks; mechanical specifications; beam position controls and readout; patient support couch; simulator; non-therapy use of the accelerator; automatic control system; and reliability and maintainability are discussed. (W.H.K.)

25549 (ESD-203) APPLICATION OF RELIABILITY ENGINEERING CONCEPTS TO THE DESIGN OF RADIATION THERAPY ACCELERATORS. Herring, D. F.; Dobson, J.; Potenza, R. M. (Enviro-Med, Inc., La Jolla, Calif.). 17 Apr 1970. 48p. (CONF-710503-1).

From International symposium on RNA viruses and host genome in oncogenesis, Amsterdam, Netherlands (12 May 1971).

For Stanford Univ., Calif., Dept. of Radiology.

The design and beam specifications for the CRTS (Committee for Radiation Therapy Studies) electron linac are presented and discussed. The linac accelerates electrons up to 30 MeV and can be operated as either an electron source or an x-ray source for therapy. Reliability engineering is applied to the design and construction of the linac to assure a satisfactory level of performance. (W.H.K.)

25550 (ESD-207) FIELD FLATNESS, SYMMETRY AND PENUMBRA SPECIFICATIONS FOR THE CRTS PROTOTYPE ACCELERATOR. (Enviro-Med, Inc., La Jolla, Calif.). 17 Apr 1970. 39p. (CONF-710503-2).

From International symposium on RNA viruses and host genome in oncogenesis; Amsterdam, Netherlands (12 May 1971).

For Stanford Univ., Calif., Dept. of Radiology.

The dose distribution of the x-ray beam from an electron linac for radiotherapy is studied. Beam properties are examined including the central axis depth dose; field flatness (the degree of variation in the dose distribution in a plane normal to the central axis at a given depth); penumbra (the sharpness of the dose fall-off in the vicinity of the field boundary); and field symmetry. Also, the basic processes in the production of a therapeutically useful beam of x rays are reviewed. (W.H.K.)

25551 (ESD-210) SUMMARY OF THE CRTS PROTOTYPE ACCELERATOR SPECIFICATIONS. (Enviro-Med, Inc., La Jolla, Calif.). 30 Apr 1970. 17p. (CONF-710503-3).

From International symposium on RNA viruses and host genome in oncogenesis, Amsterdam, Netherlands (12 May 1971).

For Stanford Univ., Calif., Dept. of Radiology.

Performance specifications for the CRTS (Committee for Radiation Therapy Studies) electron linac for radiotherapy are summarized. Electron beam specifications; photon beam specifications; radiotherapy instrumentation, controls, and interlocks; mechanical specifications; beam position controls and readout; patient support couch; simulator; non-therapy use of the accelerator; automatic control system; and reliability and maintainability are discussed. (W.H.K.)

25552 (HASL-240) NEUTRON SPECTRA IN THE SIDE-SHIELDING OF A LARGE PARTICLE ACCELERATOR. O'Brien, Keran (New York Operations Office (AEC), N. Y. Health and Safety Lab.). Jan 1971. 31p. Dep. NTIS.

Neutron spectra covering the range from thermal to 500 MeV in the side-shielding of high energy electron and proton accelerators have been calculated. Shield thicknesses vary from 100 to 2000 g/cm^2 of earth and iron. The results should be applicable to particle accelerators with energies greater than 0.8 GeV under conditions of uniform beam loss. (auth)

25553 (HMI-B-103) CYCLOTRON COMBINATION FOR ACCELERATION OF HEAVY IONS. (Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany)). Jan 1971. 27p. (In German). Dep. NTIS (U. S. Sales Only).

A proposal was made to equip the Hahn–Meitner Institut with a heavy ion accelerator which would accelerate ions up to a mass of 40 to 280 MeV or 7 MeV/nucleon. Other characteristics of the accelerator would be continuous variability of the energy up to 20% of the maximum energy, good energy precision, and very flexible pulse range from the nanosecond to the millisecond range. The installation would consist of two isochroncyclotrons operating in series, which could be used independently of each other. The investment costs of the total project would be about 36 Mio DM, of which approximately a third would be attributed to the accelerator, the new construction, and the experimental devices. (tr-auth)

25554 (IAE–1974) EXPERIMENTAL STUDY OF PLASMA FOCUSING OF ION BEAMS. Zhukov, V. V.; Morozov, A. I.; Shchepkin, G. Ya. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Atomnoi Energii). 1970. 36p. (In Russian). Dep. NTIS (U. S. Sales Only).

This work presents the results from experimental investigation of plasma focusing using models of plasma lenses. It is demonstrated that plasma focusing in a simple system with closed electron drifts is actually realized in good agreement with the theory. The refracting force is considerably greater than in ordinary electrostatic or magnetic "vacuum" lenses. (JPRS)

25555 (IFVE-OP-70-28) HIGH INTENSITY NEGATIVE PARTICLE BEAM WITH MOMENTUM OF 10 TO 16 GeV/c. Golovnya, N. I.; Grachev, M. I.; Gubrienko, K. I.; (and others) (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1970. 10p. (In Russian). NTIS (U. S. Sales Only).

A beam channel of secondary particles in the momentum range of 10 to 16 GeV/c and beam intensity up to 10^7 per pulse is described. Characteristics of the beam are given and properties of the beam channel optic system are discussed. Data are given on π^-, K^-, antiproton, and antideuteron beams. (auth)

25556 (IFVE-SKU-70-6) METHODICS OF MEASURING THE INLEAKAGE IN THE LOW STRONG VACUUM FLASK. Pronin, O. D.; Rogozinskii, V. G. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1970. 9p. (In Russian). NTIS (U. S. Sales Only).

The methodics of measuring the inleakage in the low strong flasks has been worked out and experimentally checked. Under a pressure of 560 torr it is possible to measure a specific inleakage with an error of about 0.01 cm^3 at./hour l. (auth)

25557 (IFVE-SKU-70-15) PHASE MOVEMENT OF THE INTENSIVE BEAM IN A PROTON-SYNCHROTRON WITH STRONG FOCUSING. Pashkov, P. T.; Shukeilo, S. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1970. 13p. (In Russian). NTIS (U. S. Sales Only).

The influence of a space charge on the beam phase movement in the strong-focussing proton synchrotron has been studied. The solution of the phase equation taking into account the influence of the electrical self field of the bunches in case of nonlinear synchrotron oscillations has been obtained. The numerical calculations have been made for the IHEP Synchrotron in the analog computer MH-7. (auth)

25558 (IFVE-SKU-70-27) THE USING OF AN IONIZATION FRICTION TO STORE HEAVY PARTICLE BEAMS. Ado, Yu. M.; Balbekov, V. I. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1970. 19p. (In Russian). NTIS (U. S. Sales Only).

The possibility of storing heavy particle beams in a constant phase space is considered. The phase density is increased by friction forces caused by ionization energy losses in a substance that is introduced into the storage ring chamber. The storage is considered taking into account the Coulomb scattering, statistical fluctuations of ionization energy losses, nuclear interactions and charge exchange. The stationary beam dimensions and particle losses are found. The oscillation damping is particularly effective at the energy of a few MeV. A 1.5 MeV proton storage ring with a hydrogen target is considered. (auth)

25559 (JINR–E13-5621) RADIATION-RESISTANT FILM TARGET. Akimov, Yu. K.; Selivanov, G. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1971. 5p. Dep. NTIS (U. S. Sales Only).

A rotating film target for nuclear particle beams is described. The peculiarity of this target is that the film is fastened in its central part to the disc and rotated in vacuum in order to increase film thermal and radiation resistance. As a result of this fact, a free peripheral part of the film is straightened in the rotation plane under the effect of centrifugal forces and this makes it possible to have a target with constantly varying radiated spot without any frames or holders along the beam path. (auth)

25560 (JINR–P3-5537) NEUTRON-OPTICAL PROPERTIES OF THE SIX-POLE MAGNET CONSIDERING THE EFFECT OF GRAVITY. Matora, I. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1970. 8p. (In Russian). Dep. NTIS (U. S. Sales Only).

It is shown that the optical axis of a straight horizontal six-pole magnet in the Earth's gravitational field is displaced for the focused neutrons downwards from the six-pole magnet axis by the distance (independent of the neutron energy) at which the weight of a neutron is equalized by the effect of the inhomogeneous magnetic field on its magnetic moment. This circumstance can be effectively used in constructing neutron-optical systems that have no points in the working area of the field where the magnetic field is small. (auth)

25561 (JINR–P9-5590) THIN FIELD SHIMMING BY THE MODEL OF THE MAGNETIC SYSTEM FOR PHASOTRON WITH SPACE VARIATION. Alenitskii, Yu. G.; Vorozhtsov, S. B.; Zaplatin, N. L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1971. 20p. (In Russian). Dep. NTIS (U. S. Sales Only).

The results of thin shimming of the magnetic field of the phasotron with space variation are described. Under conditions of the magnetic system model, the accuracy of the field formation of ±20 e was obtained. (auth)

25562 (JINR–P9-5601) HIGH-CURRENT INDUCTION LINEAR ACCELERATOR OF THE NANOSECOND RANGE. Gitt, V. D.; Kovalenko, A. D.; Ryl'tsev, P. I.; Sarantsev, V. P. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1971. 9p. (In Russian). Dep. NTIS (U. S. Sales Only).

The experimental data on constructing the high-current induction linear accelerator of the nanosecond range, meant to be used as injector in the collective ion accelerator, are presented. The problems are considered which are connected with the formation of powerful current pulses and voltage with the creation of the accelerating system on ferrite rings, as well as with the focusing and transportation of the electron beam. (auth)

25563 (JINR–P13-5559) ION SOURCE WITH SOLID STATE WORKING SUBSTANCE. Vladimirov, A. I.; Saenko, V. A.; Tret'yakov, Yu. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1971. 12p. (In Russian). Dep. NTIS (U. S. Sales Only).

The solid matter ion source is based on the plasma-beam discharge. The working substance is obtained by evaporating with the aid of the electron beam generating the discharge. The discharge can be burnt in the material vapors of any conductivity in a wide range of the melting points. The source was tested with W, Mo, $CaCO_3$, Si, and Zn. (auth)

25564 (LA–4578) PROCEEDINGS OF THE FOURTH LAMPF USERS MEETING, OCTOBER 30–31, 1970. Agnew, Lewis E.; Harper, Katherine; Miller, Billie F. (comps.) (Los Alamos Scientific Lab., N. Mex.). Mar 1971. Contract W-7405-eng-36. 94p. Dep. NTIS.

A summary of the activities of the working groups is presented. Topics include the stopped muon channel, low energy pion channel, energetic pion channel and spectrometer, high energy pion channel, nucleon physics laboratory, high resolution proton spectrometer, nuclear chemistry, and the computing facilities. A brief description of the planned experimental facilities is presented. (W.H.K.)

25565 (LA–4612) A METHOD FOR MEASURING THE ENERGY AND INTENSITY OF A PROTON BEAM BY DETECTING FORWARD SCATTERED ELECTRONS. Gram, Peter A. M. (Los Alamos Scientific Lab., N. Mex.). Dec 1970. Contract W-7405-eng-36. 11p. Dep. NTIS.

By using a GeLi detector to measure, with high precision, the energy of electrons scattered forward by the proton beam in a thin beryllium foil, it appears possible to measure the proton energy (around 800 MeV) to better than 0.1%. (auth)

25566 (LA-tr-71-1) QUADRUPOLES EXPOSED TO RADIATION. Perret, Ch.; Petitjean, C.; Schwedtmann, K.; Tscha-

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laer, Ch.; Wagner, E. Translation of German report SIN-TM-08-5. 15p. Dep. NTIS.

The design of quadrupole magnets for transporting pion beams in intense radiation fields is considered. Two standard quadrupole types (differing in size) are proposed for all radiation-exposed target discharges. Higher power costs (due to greater resistivity) for Al must be weighed against corrosion of Cu for water cooling. Both problems can be eliminated by cooling with gaseous He, but extra expenditures are incurred for He gas blowers. (R.W.R.)

25567 (LA-tr-71-18) CONSIDERATIONS FOR THE CONSTRUCTION OF A HELICAL LINEAR ACCELERATOR FOR PROTONS. Mueller, W.; Rembser, J. Translated for Los Alamos Scientific Lab., N. Mex., from Nucl. Instrum. Methods; 4: 202-12(1959). 23p. Dep. NTIS.

A short qualitative discussion of the field distribution in the interior of the waveguide is given, and the high-frequency characteristics of the helical waveguide are discussed. Also, the problem of winding the helix is considered. (W.H.K.)

25568 (LAL-1241) REPORT ON ACTIVITIES, MAY 1, 1969-MAY 1, 1970. (Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire). Nov 1970. 96p. (In French). Dep. NTIS (U. S. Sales Only).

The electron linear accelerator has operated normally and some tests on the utilization of the linac as an injector for a ring were made. Some technical improvements are reported. The performance of the electron-positron collision ring ACO and work done to facilitate its maintenance and improve its performance are reported. Theoretical studies were made on the behavior of the beam in the electron-positron rings and on the beam dynamics. The design considerations made on the 2×1.5 GeV collision ring with great luminosity are summarized. The development of techniques and methods of analyzing bubble chamber pictures was continued. In the study of the creation of pairs the experimental points for Be, Al, and Pt are in good agreement with the theoretical curves. Experiments on positron-electron elastic scattering at 180° verify the new formulation of radiative corrections of Yennie, Hearn, and Kuo. Also, completed experiments in nuclear physics, bubble chamber physics, and high energy physics at CERN are reported, and planned studies are briefly indicated. Publications made during the year are listed. (J.S.R.)

25569 (LNF-70/52) RESONANT DEPOLARIZATION OF THE ELECTRON BEAM UNDERGOING ACCELERATION IN THE SYNCHROTRON. Turrin, A. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). Dec 1970. 13p. (CONF-701121-1). Dep. NTIS (U. S. Sales Only).

From Meeting on electronsynchrotron; Frascati, Italy (5 Nov 1970).

The possibility of accelerating vertically polarized electron beams to high energies in the Frascati Synchrotron is pointed out. (auth)

25570 (MPI-PAE/EXTRATERR-31) CONSTRUCTION OF A PROTON SOURCE FOR THE ENERGY RANGE 2 TO 13.5 MeV. Vollmer, O. (Max-Planck-Institut fuer Physik und Astrophysik, Munich (West Germany)). Jul 1969. 63p. (In German). Dep. NTIS (U. S. Sales Only).

A proton source which yields protons with energies between 2 and 13.5 MeV is described. These are recoil protons produced by monoenergetic 14.1-MeV neutrons in a thick plastic scintillator (NE 102 A). A continuously working neutron tube is used as neutron source. Two different coincidence arrangements are used for energy selection of the recoil protons and for suppression of the background. For proton energies between 13.5 and 7 MeV the energy loss of the recoil protons in the target scintillator measured with a multiplier is used for energy selection. The energy resolution was determined by the target scintillator and is between 700 keV FWHM at 13.5 MeV and 1200 keV FWHM at 8 MeV. For energies under 8 MeV, energy selection is best made with a $\Delta E/\Delta x$ semiconductor counter. The resolution is 900 keV FWHM at 8 MeV and 550 keV FWHM at 2 MeV. The rate of counted protons is about 15 pulses/hr. A detector, with which absolute flux measurements of fast monoenergetic neutrons are possible, was constructed for the determination of the neutron production rate of the neutron tube used. It depends on the detection of recoil protons from a thick polyethylene target with two $\Delta E/\Delta x$ semiconductor counters wired in coincidence. (tr-auth)

25571 (NAL-50) PROGRESS AND PROSPECTS AT THE NATIONAL ACCELERATOR LABORATORY. Malamud, Ernest; Walker, James K. (National Accelerator Lab., Batavia, Ill.). Dec 1970. Contract AT(49-8)-3000. 18p. (CONF-700806-57). Dep. NTIS.

From 15. international conference on high energy physics; Kiev, USSR (26 Aug 1970).

A general review is given of the progress on the NAL 500-GeV synchrotron. Both the accelerator and experimental areas are discussed. (auth)

25572 (NP-18724) NUMERICAL INVESTIGATION OF A REDUCED FORM STRUCTURE (REENTRANT CAVITY) FOR SUPERCONDUCTING PROTON LINEAR ACCELERATOR IN THE ENERGY RANGE 1- TO 60-MeV. Hirschmann, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Apr 1970. 43p. (In German). Dep. NTIS (U. S. Sales Only).

Superconducting RF-structures in accelerators should be of small size and simple shape in order to reduce losses by heat radiation and to provide high mechanical stability. Thus iris-type structures seem attractive even when applied to non-relativistic particles. A 600 Mc "reentrant cavity" structure for low energy protons is calculated under a systematical variation of the structural dimensions. It is shown that the outermost diameter may be chosen very small, if the cavities are tuned by drift tubes of suitable thickness. Optimal sets of structural parameters are drawn from the calculations of shunt impedance and the transit time factor. The RF-losses are estimated under reasonable assumptions about the improvement factor and the strength of the average electric field. It is seen that the superconducting structure is appropriate to accelerate protons with an energy above 2 MeV. (auth)

25573 (ORNL-TM-3332) TRENDS IN THE UNITED STATES FOR THE ACCELERATION OF HEAVY IONS. Livingston, Robert S.; Martin, John A. (Oak Ridge National Lab., Tenn.). Jan 1971. Contract W-7405-eng-26. 27p. (CONF-710209-2). Dep. NTIS.

From International conference on heavy ion physics; Dubna, USSR (11 Feb 1971).

The performance of US accelerators for heavy ions is compared. The review includes existing accelerators, those under construction, and proposed accelerators. The desirable characteristics for a forefront heavy ion accelerator are listed. A description of the super-HILAC conversion serves to high-light the discussion of progress in the United States. As an example of the possibilities and limitations of present-day isochronous cyclotrons, the heavy ion acceleration capabilities and use of the Oak Ridge Isochronous Cyclotron are discussed. The report briefly reviews the possibilities of new concepts including superconducting linear accelerators and supervoltage tandems. The performance characteristics of major existing and proposed European accelerators are compared. (auth)

25574 (RHEL/R-209) SOME ENGINEERING ASPECTS OF THE NIMROD THIN SEPTUM EXTRACTION SYSTEMS AND COMPONENTS. Moore, D. R. (Rutherford High Energy Lab., Chilton (England)). Sep 1970. 85p. Dep. NTIS (U. S. Sales Only). UK 75p.

The plunging mechanisms, magnets and target mechanisms used with the NIMROD extraction systems are described. Experience over the past years has shown the obvious advantages to operation and maintenance crews of designing for reliability, easy access, modular construction, and quick interchange of components. The extraction system requirements and design criteria are stated. (auth) (UK)

25575 (RHEL/R-210) NIMROD OPERATION AND DEVELOPMENT. Quarterly Report, July 1-September 30, 1970. Gray, D. E. (ed.) (Rutherford High Energy Lab., Chilton (England)). Dec 1970. 13p. Dep. NTIS (U. S. Sales Only). UK 15p.

The Nimrod beam was on for high energy physics research for 89.4% of HEP scheduled operating time. One experiment was completed, six continued through and one commenced in this quarter. Some notes are given on a time structure analyzer used for monitoring high frequency components of beam structure. (UK)

25576 (RHEL/R-211) NIMROD OPERATION AND DEVELOPMENT. Quarterly Report, October 1-December 31, 1970. Gray, D. E. (ed.) (Rutherford High Energy Lab., Chilton (England)). Jan 1971. 14p. Dep. NTIS (U. S. Sales Only). UK 20p.

The Nimrod beam was on for high energy research for 92.2% of HEP scheduled operating time. Three experiments were completed and six continued through in this quarter. Some notes on the new π11 (Radiobiological) beam line are given. (auth) (UK)

25577 (SLAC-Trans-129) POSSIBILITY OF COMPENSATING A BEAM ENERGY SPREAD DUE TO CURRENT LOADING. Grishaev, I. A.; Gritsenko, V. N.; Ivanov, G. M.; Makhenko, P. A. (Akademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut). Translated for Stanford Linear Accelerator Center, Calif., from report KHFTI-70-19. 10p. Dep. NTIS.

A method which ensures complete energy-spread compensation for any number of accelerator sections in the transient regime is proposed. The method involves a variation of the output bunch phase in the injector during the pulse in accordance with a law that ensures an equal increment in the energy of the particles in each bunch in the main accelerating channel. The fact that different bunches experience beam radiation fields of different amplitude is taken into account. The compensation conditions can also be satisfied by changing the phase velocity of the wave during the pulse in the main part of the accelerator. Calculations and measurements obtained in the course of applying the above method of compensation are reported. (R.W.R.)

25578 (UCRL-20150) ELECTRON-RING ACCELERATOR PROGRAM AT BERKELEY. Peterson, J. M.; Chupp, W. W.; Garren, A. A.; Keefe, D.; Lambertson, G. R.; Laslett, L. J.; Perkins, W. A.; Sessler, A. M. (California Univ., Berkeley. Lawrence Radiation Lab.). 20 Oct 1970. Contract W-7405-eng-48. 21p. (CONF-701120-2). Dep. NTIS.

From 2. national conference on particle accelerators; Moscow, USSR (11 Nov 1970).

The Compressor 2 and Compressor 3 experiments are discussed, and the development of a new 4-MeV 500-A electron linear induction accelerator is described. An outlook into the future possibilities of electron-ring accelerators is given. (W.H.K.)

25579 (UCRL-50935) INVESTIGATION OF THE POSSIBLE PRODUCTION OF A NANOSECOND PULSE OF 14-MeV NEUTRONS AND THE ACCELERATION OF IONS BY 7-kA PULSED ELECTRON BEAMS. VanDevender, J. P. (California Univ., Livermore. Lawrence Radiation Lab.). 16 Sep 1970. 14p. Dep. NTIS.

An attempt to produce a nanosecond burst of 14-MeV neutrons with the $T(d,n)^4He$ reaction by accelerating deuterons with available 7-kA electron beams is reported. Acceleration of ions by high-current (5- to 200-kA), relativistic (0.5- to 2-MeV) electron beams is investigated. Previous experimental and theoretical work is reviewed and compared. Arguments are presented to explain the experimental observations by a combination of electrostatic and magnetic acceleration mechanisms, with magnetic acceleration dominating if $(v/\gamma) \leq 1$ and with electrostatic acceleration dominating if $(v/\gamma) \gg 1$. In experiments with two 7-kA electron beams of energies 600 keV and 2 MeV, no ion current greater than 0.01 A was observed. The negative result suggests a strong current dependence for the accelerating mechanism. Another experiment is proposed to utilize the dual-mechanism theory by incorporating an external magnetic field and a moderate current (7-kA) electron beam to accelerate the ions. (auth)

25580 (UJV-2498-F) SOME PROPERTIES OF THE ION MOTION IN THE CYCLOTRON U-120. Borek, M.; Hrda, A. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). [nd]. 42p. Dep. NTIS (U. S. Sales Only).

The ion motion in the U-120 cyclotron is considered. A method of solution of the ion motion in the median plane of a cyclotron is described, and some results are discussed which have been obtained by employing this method in connection with the relation between the parameters of the cyclotron and the intensity of the internal and external beam as well as by energetic dispersion of the beam on the inlet into the deflector. Further, the vertical motion of ions in the $r \geq 10$ cm region has been solved. The influence of the electric and magnetic fields is taken into consideration as well as the influence of the space charge on vertical motion of ions in a linear approximation. (auth)

25581 ELECTRON ACCELERATORS USED AS IONIZING RADIATION SOURCES. Gerbier, R. (CEA, Grenoble, France). Tech. Mod.; 62: 417-21(Oct 1970). (In French).

The power and penetration of electron beams are discussed, and two sources suitable for producing industrial radiation are described: linear accelerators (energy between 3 and 10 MeV) and electrostatic accelerators (energy between 200 keV and 4 MeV). Some examples are presented. (France)

25582 ACCELERATION OF PARTICLES BY COLLECTIVE FIELDS. II. Laslett, L. Jackson; Sessler, Andrew M. Comments Nucl. Particle Phys.; 4: 211-18(Nov-Dec 1970).

The basic phenomena that govern the design and operation of an electron-ring accelerator for proton or heavy ion acceleration to high energies are discussed. A brief summary is also given on the present status of the electron-ring accelerator development. (L.B.S.)

25583 ENGINEERING PROBLEMS WITH FACILITY OF HIGH ENERGY ELECTRON LINAC. 2. SHIELD DESIGN FOR THE TOHOKU UNIVERSITY ELECTRON LINEAR ACCELERATOR. Yamamoto, Moriyuki (Taisei Construction Co. Ltd., Tokyo). Genshiryoku Kogyo; 16: No. 6, 73-9(Jun 1970). (In Japanese).

The 300-MeV electron linear accelerator in Tohoku University was completed in October 1967. It consists of a klystron, linear acceleration region, beam deflectors, laboratories, and neutron tunnel. The overall system of this linear accelerator is semi-underground, with the klystron room located above the linac room. The shield is concrete + sand + concrete between the klystron and linac rooms, and magnetite heavy-concrete between deflector and laboratory rooms. (Japan)

25584 ENGINEERING PROBLEMS WITH FACILITY OF HIGH ENERGY ELECTRON LINAC. 3. EXPERIMENTS ON THE TOHOKU UNIVERSITY ELECTRON LINEAR ACCELERATOR. Tanaka, Shunichi (Japan Atomic Energy Research Inst., Tokai). Genshiryoku Kogyo; 16: No. 7, 75-9(Jul 1970). (In Japanese).

The spatial distribution of neutrons and gamma-rays has been measured for the (300-MeV) electron linear accelerator at the Tohoku University, to check the values of calculation made in the design stage including linac, electromagnet, laboratory rooms, and labyrinths. For these measurements, both the integral and differential types of detectors were employed appropriately. For neutron measurements various threshold detectors, BF_3 detectors, survey meters, and dosimetry film were used. For γ-ray measurements fluorescent glass dosimeters, and survey meters and film were used. In the electromagnet room with the highest neutron flux expected, each detector recorded only 10^3 to 104 cpm. Relatively high neutron dose-rates were detected over labyrinths probably due to the nearby air-conditioning ducts. (Japan)

25585 ELECTRON EMITTING CATHODES FOR IRRADIATION MACHINES. Fuller, Robin Walker Ellecker (to United Kingdom Atomic Energy Authority). U. S. Patent 3,534,218. 13 Oct 1970. Priority date 30 Mar 1967, Great Britain.

An electron emitting cathode which comprises a flexible graphite filament having a coating of a material which emits electrons when heated is described. The filament may be tubular and loosely supported on a metal core wire. (auth)

25586 EXCITATION OF RADIAL BETATRON OSCILLATIONS BY LONGITUDINAL ACCELERATING FIELD. Ivanov, Yu. S.; Kuz'min, A. A.; Senatorov, G. F. At. Energ. (USSR); 29: 467-9(Dec 1970). (In Russian).

A method is suggested for excitation of radial coherent betatron oscillations by a resonance method that is in contrast to the method proposed by A. A. Kolomenskii et al. (Theory of Cyclic Accelerators, M. Fizmatgiz, 1962). The constraining periodic force does not change the transverse pulse but instead it changes the longitudinal pulse of the beam center of gravity. The experiments enabled measuring of the frequency of the radial betatron oscillations and the relation between the radial and vertical oscillations at various points of the cycle up to the energy of the order of 2 GeV. With the energy exceeding 2 GeV one accelerating union was not able to excite the betatron oscillations up to the amplitude required for satisfactory measurements (~0.5 mm). The results showed satisfactory effectiveness of the method for exciting radial betatron oscillation at small energies. (R.V.J.)

25587 METHOD OF MEASURING ION BEAM HOMOGENEITY. Roosild, Sven A.; McLaughlin, Walter A.; Lowe, Lester F. (to Secretary of the Air Force). U. S. Patent 3,556,658. 19 Jan 1971. Filed 14 Jan 1970.

A method for measuring ion beam homogeneity in high energy accelerating equipment by placing a wafer of a thermal oxide in the path of the beam, bombarding the wafer with ions, etching the wafer with acid and measuring the discontinuity in the bombarded surface to determine the location of variations in intensity in the beam is described. (auth)

25588 HIGH INTENSITY LINEAR ACCELERATORS. Croitoru, Petrica (to Institutul de Fizica Atomica). British Patent 1,220,496. 27 Jan 1971. Priority date 10 Apr 1967, Rumania.

A high-intensity linear accelerator is described in which the beam is injected and accelerated in the form of a hollow tube. After acceleration the beam is focused to a line along the longitudinal axis of the machine. Several tubular beams of different radii, as well as a conventional line beam, can be accelerated simultaneously in the device if desired. (R.W.R.)

25589 APPARATUS FOR NONDESTRUCTIVELY MEASURING THE POSITION AND PARTICLE-DENSITY PROFILE OF AN ACCELERATOR BEAM. Hornstra, Fred Jr.; de Luca, William H. (to United States Atomic Energy Commission). U. S. Patent 3,546,577. 8 Dec 1970. Filed 26 Jun 1968.

An apparatus for nondestructively measuring the position and

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particle-density profile of an accelerator beam operating in a residual gas of a partial pressure wherein the accelerator beam ionizes the residual gas includes a pair of electrodes mounted parallel to the accelerator beam on opposing sides thereof. A voltage source applies a potential between the electrodes to generate an electric field normal to the accelerator beam wherein the residual gas ions are accelerated. Ion-collecting means are mounted to intercept the accelerated residual gas ions to provide a profile measure of the accelerator beam. (auth)

25590 IMPEDANCE MATCHING COUPLER SYSTEM FOR A VARIABLE RESISTIVE LOAD IMPEDANCE. McConnell, Roger A. (to United States Atomic Energy Commission). U. S. Patent 3,544,922. 1 Dec 1970. Filed 4 Apr 1969.

A coupler system for efficiently coupling power from a radio-frequency source to a varying resistive load, including a series tuned input circuit connected to the source, a series tuned output circuit connected to the load, and a tuned linking circuit having a single inductance coupled to input and output circuit inductances is described. The sum of the coefficients of coupling remains constant and the circuits remain tuned when the linking inductance is moved with a servo into greater or less flux linkage with the input and output circuit inductances to match the load impedance to the source. (auth)

25591 PARTICLE ACCELERATORS. 7. MEDICAL LINEAR ACCELERATORS. Kondo, Tamio (National Inst. of Radiological Sciences, Chiba, Japan). Hoshasen Kagaku; 12: No. 11, 173-7(Nov 1969). (In Japanese).

The medical linear accelerators which are used today are compact electron linear accelerators which utilize a traveling wave accelerating tube. The principle of linear accelerators, including phase focusing, is explained briefly and then the historical development of medical linear accelerators is reviewed. Also, the components of medical linear accelerators are described including the accelerating wave guide, electron gun, target and irradiation apparatus, mechanical mount, high-frequency electric power supply, and modulator and controller. (Japan)

25592 CONTROL AND HOMOGENIZATION OF ELECTRON BEAMS FROM A 35 MeV BETATRON. Van Dam, J.; Prignot, M.; Cresens, A.; Wambersie, A.; Debois, J. M. J. Belge Radiol.; 53: 201-3(May-Jun 1970). (In French).

Some practical solutions are described concerning the problems of checking the electron beam and improving its homogeneity from a 35 MeV betatron. Single coated films are used for checking the fields, their lower sensitivity allowing to integrate doses up to about one hundred rads. The homogeneity of the fields is improved by an additional scattering foil, whose positioning technique is outlined. (auth)

25593 IMPROVED SAFETY SYSTEM. Hartin, W. J. (Brookhaven National Lab., Upton, N. Y.); Goodman, L. J. Health Phys.; 20: 73-81(Jan 1971).

A new safety system approach, based on the use of integrated circuit modules, has been developed for the Brookhaven Radiological Research Accelerator Facility. The basic unit of the system is the "And" circuit. This is an inexpensive solid state logic module, having the property that all input conditions must be fulfilled in order to produce an output. As a further refinement, the "And" units are used in two independent logic lines, both of which must be satisfied in order to operate the facility. The use of parallel logic lines makes it possible to monitor circuit operation by comparing similar points on the two lines. Automatic checking of the circuits is being added to the system. The use of integrated circuit modules makes it feasible to build a complex system which is still quite flexible. These modules have capabilities which can be useful in a wide variety of safety systems. (auth) (UK)

25594 VACUUM SYSTEM FOR STANFORD STORAGE RING, SPEAR. Cummings, U.; Dean, N.; Johnson, F.; Jurow, J.; Voss, J. (Stanford Univ., Calif.). Contract AT(04-5)-515. J. Vac. Sci. Technol.; 8: 348-51(Jan-Feb 1971).

From 17th National Meeting of the American Vacuum Society, Washington, D. C. See CONF-701011.

Due to its unusual geometry and gas load, the SPEAR vacuum system incorporates several unique design features. The system consists of an aluminum chamber in the form of a 200-ft-diam ring which must achieve a pressure in the 10^{-9} Torr range with a large gas load due to synchrotron-radiation-induced desorption. Since the system is conductance limited, it was necessary to develop distributed sputter-ion pumps located within the chamber proper. A large number of aluminum-stainless-steel interfaces required the development and testing of various flange arrangements which would withstand a bakeout to 200°C. (auth)

25595 COMPUTER CONTROL OF VAN DE GRAAFF ACCELERATOR VACUUM SYSTEMS. Woods, R.; Jennings, H. K.; Collins, M. W.; Harder, D. G.; McMillan, D. E. (Los Alamos Scientific Lab., N. Mex.). J. Vac. Sci. Technol.; 8: 352-6(Jan-Feb 1971).

From 17th National Meeting of the American Vacuum Society, Washington, D. C. See CONF-701011.

The seven main diffusion-pump vacuum systems on the Los Alamos Tandem Van de Graaff accelerator are controlled by a Honeywell H610 digital control computer. Each system has a local control panel with a hardwire protection shutdown system but no recovery capability. Control is normally left to the computer, which, through analog and digital inputs, senses trouble and secures the system according to the difficulty. The computer then recovers the systems completely or to the level of the difficulty. The computer operators' console includes control buttons to enable/disable the securing function or the recovery function for a system. An alarm typewriter informs the operator of any action that the computer has taken, including which inputs are out of limit. An Adage AGT-10 display system shows each vacuum system and the status of each input. This takes the place of the usual remote indication panel. (auth)

25596 FIRST OBSERVATION OF COLLIDING BEAM EVENTS IN THE CERN INTERSECTING STORAGE RINGS (ISR). Phys. Lett.; 34B: 425-7(15 Mar 1971).

Recently the first colliding beam events were detected in the CERN ISR. The counting rates due to colliding beam events were between one and two orders of magnitude larger than the rates of accidentals caused by background and agreed within a factor 2 with the calculated luminosity. (auth)

25597 EXPERIMENTS WITH A PLASMA BETATRON. Bermel, W.; Fricke, K. H. (Univ., Bonn). Z. Phys.; 242: 342-51(1971). (In German).

Recently reported measurements on a plasma betatron M II were continued and under certain conditions bremsstrahlung produced by relativistic electrons was observed associated with conduction currents of some 100 A. But also early beam disruption occurred. The time τ_Y of disruption of the stream has been measured as a function of gas pressure and acceleration field strength. Most of the electrons were lost during an early stage of the acceleration process but also beam loss was observed over a long period of the acceleration time. The expected increase of the circulating runaway current due to improved parameters was not found. (auth)

25598 PARTICLE ACCELERATORS IN THE EUROPEAN COMMUNITY. Brussels; European Atomic Energy Community (1970). 188p. (In several languages).

A listing of accelerators in the European Community is presented. The type of machine, location, performance, application, and other features are presented. (W.H.K.)

25599 FACILITY FOR RESONANCE-FLUORESCENCE EXPERIMENTS USING AN ELECTRON LINAC. Shikazono, N.; Kawarasaki, Y. (Japan Atomic Energy Research Inst., Tokai). Nucl. Instrum. Methods; 92: 349-57(1971).

A facility for the study of resonant scattering of gamma rays is described. Bremsstrahlung gamma rays from an electron linac are used as the gamma-ray source and resonantly scattered gamma rays are detected by a Ge(Li) detector. Gamma rays scattered from ^{11}B are used for the energy calibration. The principal features and characteristics of the facility are discussed. Gamma-ray spectra resulting from the photon bombardment of boron and fluorine are shown. A method of determining radiative width is described. (auth)

25600 BEAM POSITION MONITOR FOR ACCELERATED ELECTRONS. Prudnikov, I. A.; Toropov, A. S. (Scientific Research Inst. of Electrophysical Apparature, Leningrad). Nucl. Instrum. Methods; 92: 359-60(1971).

The construction of a beam position monitor for accelerated electrons is described, which practically has no influence on beam parameters. The monitor operation is based on the effect of secondary electron emission from surfaces of thin metal foils, when the high-energy electron beam passes through them. A technique for experimental definition of the monitor sensitivity is presented. The monitor registers the beam position variations of ±0.2 mm. The block-diagram for measurement is given. (auth)

25601 CALCULATION OF VOLTAGE SURGES IN VAN DE GRAAFF GENERATORS. Kiss, A. (Inst. of Nuclear Research, Debrecen, Hungary). Nucl. Instrum. Methods; 92: 361-3(1971).

Calculations have been made to determine the voltage surge amplitudes in the stack of Van de Graaff generators subsequent to the breakdowns between the equipotential rings and the earthed

tank. The presented formulae include the case of breakdowns between the high voltage terminal and the earthed tank, too. The results show considerable effect of the sparkovers between some equipotential rings in the vicinity of the terminal and the earthed tank on the voltage surges. The application of surplus capacitances suggested earlier decreases the voltage surge amplitudes. However what seems to be the most effective solution is to shield these equipotential rings by using special electrode configuration proposed as optimum shape with respect to static field distribution. (auth)

25602 EXPERIMENTAL AND THEORETICAL FRINGING FIELD INVESTIGATIONS. Czok, U.; Euler, K.; Rauscher, M.; Wollnik, H. (Justus-Liebig-Univ., Giessen, Ger.). Nucl. Instrum. Methods; 92: 365-71(1971).

An automatic scanning electrolytic tank was built for the investigation of fringing fields. In the case of two-dimensional problems, the experimental results were tested by the values which were obtained theoretically by using the method of conformal mapping. The resultant values of the relevant ion optical fringing field integrals are presented graphically. (auth)

25603 QUANTUM THEORY OF MOTION OF ELECTRONS IN CYCLIC RESONANCE ACCELERATORS. Sokolov, A. A.; Ternov, I. M.; Bagrov, V. G. Ann. Phys. (Leipzig); 25: 44-55(1970). (In German).

With linear approximation, the Klein–Gordon equation is solved for a relativistic electron without spin. The electron moves through a magnetic field that is constant, focusing and homogeneous. By means of a high-frequency electromagnetic field, the radial energy loss is compensated. The mathematical solution is applied to the study of quantum fluctuations during betatron and synchrotron oscillations. (tr-auth)

25604 PREPARATION OF ACTINIDE TARGETS BY ELECTRODEPOSITION ON ALUMINUM. Prakash, Satya; Manohar, S. B.; Singh, R. J.; Ramaniak, M. V. (Bhabha Atomic Research Centre, Trombay, India). Int. J. Appl. Radiat. Isotop.; 22: 128-9(Feb 1971).

The ideal backing material for the preparation of targets for recoil range studies is aluminium due to its availability in the form of highly pure, uniform and thin foils. The results of experiments on the preparation of targets of thorium, uranium, neptunium, plutonium and americium on aluminium backing covered with a thin layer of gold are described. Targets prepared using this method were found to be much more uniform than those prepared by earlier methods. Recoil ranges of fission fragments in the fission of ^{233}U and ^{239}Pu were determined using the targets prepared by this method. (UK)

25605 INDUSTRIAL DEVELOPMENT AND APPLICATION OF THE VAN DE GRAAFF ACCELERATOR FOR NEUTRON RADIOGRAPHY. Wilson, L. E.; Hildreth, G. A.; Fussa, A. D. (High Voltage Engineering Corp., Burlington, Mass.). Mater. Eval.; 29: 69-74(Apr 1971).

Better reaction target geometry and improved collimator designs have made possible a thermal neutron output of 1.2×10^6 n/cm^2-sec from a two-million volt Van de Graaff accelerator. The neutron-to-gamma ratio has been improved to 6×10^6 n/cm^2-mR, thus making possible high-quality direct exposures with standard industrial x-ray films. In addition, a thermal neutron real-time television viewing system has been used, and preliminary performance has been evaluated. Further effort has been expended to develop commercial applications in conjunction with aerospace, electronic, ordnance and aircraft equipment manufacturers. A facility for prototype industrial work has been in operation at the High Voltage Engineering Corp. for several months. (auth)

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PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 23918, 25200, 25244, 25250, and 25579.

25606 (INIS-mf-30) EXPERIMENTAL INVESTIGATIONS OF SOME TIME-DEPENDENT PHENOMENA IN THE SLOWING DOWN AND DIFFUSION OF NEUTRONS. Grosshoeg, G. (Chalmers Tekniska Hogskola, Goteborg (Sweden)). 1970. 16p. NTIS (U. S. Sales Only).

Measurements were performed on the slow down time of Ra–Be neutrons from a source in water by a static method. An electronic system and methods for calculating, and data handling of precision measurements by the pulsed-neutron-source methods were developed. It was shown that decay-constant variations and trapping effects were due to space dependence of the cross sections. An experimental method for eliminating this delay effect was investigated. Five of the theses reprints were earlier abstracted in NSA. (INIS)

25607 (INR–1220) REMARKS ON THE INTENSITY MEASUREMENTS IN THE NEUTRON DIFFRACTION. Dobrzynski, Ludwik (Institute of Nuclear Research, Warsaw (Poland)). 1970. 35p. Dep. NTIS (U. S. Sales Only).

The exact formulas for the intensity of Bragg-reflected neutrons are presented, and particular attention is paid to polarized neutron diffractometry. In particular, the shape and luminosity of the diffraction lines measured by different methods are considered. From the developed formulas the dependence of the polarization ratio vs the deviation angle of the sample from its Bragg position is calculated. Finally, the possible effects of crystal imperfections are briefly sketched. (auth)

25608 (JAERI-Memo–4211) THRUSH: A CODE FOR CALCULATING THERMAL NEUTRON SCATTERING KERNEL. Kadotani, H. (Japan Atomic Energy Research Inst., Tokyo). Nov 1970. 20p. (In Japanese). Dep. NTIS (U. S. Sales Only).

THRUSH is a code for computing the thermal-neutron scattering kernel by phonon expansion method in both coherent and incoherent approximations. To evaluate the scattering kernel from the double differential scattering cross section, it is necessary to perform angular integration over scattering angle. Existing codes utilize for this purpose the numerical integration of the scattering law. So as to improve the accuracy and reduce the computer machine time this integration is performed analytically in the THRUSH code. Another feature of THRUSH is that this code can calculate the coherent part of the scattering kernel as well as the incoherent part. THRUSH especially is useful for calculating the scattering kernel for heavy water. (auth)

25609 (RPI–328-225) INTEGRAL TESTS AND EVALUATION OF CROSS-SECTION DATA FROM STUDIES OF FAST NEUTRON TRANSPORT IN BULK MEDIA. Malaviya, B. K.; Kaushal, N. N.; Becker, M.; Burns, E. T.; Ginsberg, A.; Gaerttner, E. R. (Rensselaer Polytechnic Inst., Troy, N. Y.). [1970]. Contract AT(30-1)-328. 7p. Dep. NTIS.

A comprehensive program devoted to the integral checks of differential microscopic-cross-section data pertinent to the LMFBR Program, based on the study of fast neutron transport in bulk media, is described. Time-of-flight-measured fast-neutron angular flux spectra at different positions in a simple, clean, homogeneous assembly are analyzed using ENDF/B data, MC^2, and SN transport calculations. In addition, continuous-slowing-down theory is developed to complement precise calculations by indicating direct relationships between cross-section uncertainties and spectra and by permitting comparisons with other data files. The result is a well-defined integral experiment with clear-cut interpretation. Most progress was made for iron. On the basis of cross-section uncertainties in iron and of their influence on spectra, it is possible to recommend not only preferred data, but also a redirection in emphasis in differential measurements and evaluation. Similar studies are in process for other materials and for new ENDF/B versions. (auth)

25610 (RT/FI–(70)40) SOLUTION TO THE BOLTZMANN EQUATION FOR MONOENERGETIC NEUTRONS IN A FINITE SPHERE. Boffi, V. C.; Premuda, F. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). [1970]. 46p. Dep. NTIS (U. S. Sales Only).

An explicit analytical solution to the Boltzmann integro-differential equation, which governs the stationary flux distribution of monoenergetic neutrons in the interior and at the boundary of a sphere of finite radius R, is given. Results for both the angular and the total fluxes are obtained by taking a three-dimensional Fourier transform of the original Boltzmann equation. By integrating the resulting equation over all the directions of neutron motion, a linear integral equation for the transform of the total flux is derived. Once this equation is proved to be cast into the form of a Fredholm linear integral equation, it can be solved, in the Hilbert space, by resorting to the classical Hilbert–Schmidt theory. The solution is then inverted termwise to yield the total flux of monoenergetic neutrons in the original space. The result for the angular flux follows from the result for the total flux. Both critical and subcritical spheres are considered. (auth)

25611 (UCRL–50400(Vol.2)) AN INTEGRATED SYSTEM FOR PRODUCTION OF NEUTRONICS AND PHOTONICS CALCULATIONAL CONSTANTS. VOLUME 2, A BIBLIOGRAPHY OF THE EXPERIMENTAL DATA OF NEUTRON-INDUCED REACTIONS. Howerton, R. J.; Perkins, S. T.; Altamirano, C. P.; Hill, K. L. (California Univ., Livermore. Lawrence Radiation Lab.). 1 Oct 1970. 801p. Dep. NTIS.

A tabulation of the bibliographic citations in the Experimental Cross Section Information Library (ECSIL) as of October 1, 1970 is presented. The tabulation is in three arrangements: alphabetic by publications, author index, and accession number. (auth)

25612 INITIAL-VALUE PROBLEM FOR NEUTRON TRANSPORT IN A FINITE BODY WITH GENERALIZED BOUNDARY CONDITIONS. Morante, Aldo Belleni (Univ., Florence). Meccanica; 5: 253-61(Dec 1970).

The existence and the uniqueness of the solution of the initial-value problem for neutron transport in a finite convex body with generalized boundary conditions which include both the perfect reflection and the vacuum boundary condition as particular cases are proved. Moreover, it is shown that the transport operator has at least one real eigenvalue provided a perfect reflection boundary condition is valid over a finite portion of the boundary surface. Finally, the asymptotic behavior of the neutron density as $t \to +\infty$ is indicated. (auth)

25613 MEASUREMENTS OF NEUTRON SPECTRA IN LIGHT WATER. Fujita, Yosaiaki (Kyoto Univ.); Aizawa, Otohiko; Fujino, Michihara. Annu. Rep. Res. Reactor Inst., Kyoto Univ.; 3: 121-9(1970).

Measurements of steady-state energy spectra of thermal neutrons in light water poisoned with $1/v$ or non-$1/v$ absorbers were made with an electron linear accelerator facility and time-of-flight techniques. Boron, cadmium, and gadolinium were used as absorbing materials. Measured spectra are compared with calculated spectra obtained by using free-gas, Nelkin, and Haywood models for neutron scattering. For free-gas and Nelkin models, the agreement between theory and experiment is not satisfactory, and it appears that the thermalization powers of these models are a little higher. In the case of the Haywood model, the discrepancy is largely diminished. Absorption cross sections of gadolinium and cadmium are taken from Westcott representations and the evaluated values in ENDF/B. The difference between them in the case of gadolinium has little influence on the spectrum predictions, and any evaluation of them can not be made from the experiments. (auth)

25614 TRANSMISSION OF FAST NEUTRONS THROUGH MEDIA HAVING FINITE TRANSVERSE DIMENSIONS. Bozin, G. M.; Degtyarev, S. F.; Tikhonov, V. K.; Tsypin, S. G. This paper was summarized in At. Energ. (USSR); 26: 452-3(May 1969) as paper No. 294/5118. (In Russian).

Transmission of reactor neutrons with energies 0.8 to 8 MeV through cylindrical specimens of Pb, B_4C, Al, and LiH was measured. Graphs are presented of the attenuation of neutrons of various energies in lead cylinders of varying diameter d and thickness t. For thickness of 5 to 10 cm, the attenuation of neutrons of one energy groups is exponential with relaxation length $\lambda_{fin}(d)$; the equation for $\lambda_{fin}(d)$ is $\lambda_{slab} - \lambda_{fin}(d) = (\lambda_{slab} - \lambda_t)\, e^{-bd}$, where λ_t is the relaxation length for fast neutrons, λ_{slab} is that for an infinite slab, and b is a semiempirical coefficient (=0.077 for LiH, 0.028 for B_4C, 0.032 for Al, and 0.0095 cm^{-1} for Pb). (D.L.C.)

25615 METHOD AND APPARATUS FOR MODULATING THE DENSITY OF A BEAM OF PARTICLES AND DETERMINING THE VELOCITY DISTRIBUTION OF THE PARTICLES. Miller, Park H. Jr.; Whittemore, William L. (to Gulf Energy and Environmental Systems, Inc.). U. S. Patent 3,551,675. 29 Dec 1970. Filed 2 Aug 1967.

To determine the velocity distribution of particles, such as neutrons from a reactor, a beam of the particles is modulated at a first point by varying the particle density in accordance with an applied signal. The particles are detected at a subsequent point in the beam to produce a series of pulses corresponding to the detected particles, the time distribution of which is related to the applied signal and to the velocity distribution of the particles. The beam may be modulated cyclically, and the detection pulses occurring at respective times in the cycle may be accumulated. The resulting signals may then be demodulated, using some function of the applied signal, for example by a correlation technique, to produce a signal indicative of the distribution of particle velocities. The particle density may be varied by apparatus comprising a series of absorbers and transparent bodies movable alternately across the beam. (auth)

25616 NEUTRONS FROM ACCELERATORS AND RADIOACTIVE SOURCES. De Pangher, J. (Lockheed Missiles and Space Co., Palo Alto, Calif.); Tochilin, E. pp 309-59 of Radiation Dosimetry. Vol. III. /Attix, Frank H. (ed.). New York; Academic Press Inc. (1969).

The subject of neutron sources and their use is presented for the radiation research worker who occasionally uses neutron sources and is seeking simple, practical solutions to his problems. Extensive knowledge of neutron physics is not assumed. This material is designed to help him appreciate the magnitude of the problems of using neutron sources (not always evident) and to suggest solutions. The emphasis is placed primarily on monoenergetic accelerator neutron sources as tools of investigation, with radioactive neutron sources described in a supporting role. The latter are not considered to be of significant help for measuring the response of a system vs neutron energy but rather for providing a means of standardization. The problem of background radiation is also treated. (91 references) (R.W.R.)

25617 INVESTIGATION OF THE ANGULAR DISTRIBUTION OF NEUTRONS FROM AN ISOTROPIC SOURCE BEYOND LEAD AND IRON BARRIERS. Kiryushin, A. I.; Sukharev, Yu. P. This paper was summarized in At. Energ. (USSR); 26: 455(May 1969) as paper No. 297/5181. (In Russian).

Monte Carlo calculations were performed for neutrons of energy ≥0.1 and 1.0 MeV for barrier thicknesses of 5 to 20 cm. The angular neutron distribution for cos $\theta \geq 3.0$ is found to be isotropic for thicknesses up to 5 cm, and anisotropic thereafter. The angular distribution depends on θ according to $e^{A\cos\theta}$, and a graph of A vs thickness is presented for iron. (D.L.C.)

25618 ANALYSIS OF RESULTS OF THE BUREAU INTERNATIONAL DES POIDS ET MESURES THERMAL NEUTRON FLUX DENSITY INTERCOMPARISON. Murphey, W. M.; Caswell, R. S. (National Bureau of Standards, Washington, D. C.). Metrologia; 6: 111-15(Oct 1970).

The results of an international comparison of thermal-neutron flux density standards sponsored by the Neutron Working Group of the Bureau International des Poids et Mesures were analyzed using a method conceptually different from a companion analysis by Axton. Both methods, however, yield nearly the same results. All individual values are within ±2.6% of the adjusted value, the average absolute deviation being about 1%. (auth)

25619 INELASTIC SCATTERING OF THERMAL NEUTRONS FROM LIQUID HELIUM. Cowley, R. A.; Woods, A. D. B. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys.; 49: 177-200(15 Jan 1971). (AECL-3755).

The scattering of neutrons by liquid helium was studied over a wide range of wave-vector transfers, $0.2 < Q < 9.0$ Å^{-1}, and energy transfers $0 < \hbar\omega < 900$°K. The measurements were performed with both a time-of-flight rotating crystal spectrometer and a triple-axis crystal spectrometer. The scattering at 1.1°K showed a sharp one-phonon peak and a broad diffuse background. Measurements were made of the energy and intensity of both components. At large wave-vector transfers the scattering is of the form expected from a system of almost free helium atoms. Measurements of the temperature dependence of the results at the smallest and largest wave vectors were made. In the former case they show well-defined excitations above the λ point which are better defined for large wave vectors, while in the latter case they can be interpreted as giving evidence for the macroscopic occupation of the zero-momentum state. The results are compared with the available theoretical predictions. (auth) (Canada)

25620 THERMAL NEUTRON FOCUSSING BY TAPERED RECTANGULAR COLLIMATORS. Choudry, A.; Bandopadhyay, P. K. (Univ. of Rhode Island, Kingston). Nucl. Instrum. Methods; 92: 339-43(1971).

Exact analytical expressions are derived for the transmission and reflection of thermal neutrons through tapered rectangular collimators. Focussing and cold-neutron enrichment by such a collimator is investigated by simulation on a computer. (auth)

25621 LEAKAGE-PROOF NEUTRON DIFFRACTOMETER. Yanagishita, Kazuo; Iwakishi, Akira (to Mitsubishi Denki Kabushiki Kaisha). U. S. Patent 3,558,890. 26 Jan 1971. Priority date 31 Mar 1967, Japan.

A beam of neutrons passes through a hole disposed in a stationary shield and an opening disposed in a rotatable shield contained within the stationary shield and opposed to and diverging toward the hole. The beam impinges upon a crystal positioned within the rotatable shield. The crystal reflects the incident neutrons to form a beam of monochromatic neutrons which, in turn, passes through a radial hole disposed in the rotatable shield and a circumferentially wide slot disposed in the stationary shield; the beam of monochromatic neutrons is taken out from the slot. (auth)

25622 SURVEY OF INR ACTIVITIES IN SPECTRAL CODES DEVELOPMENT. Kulikowska, T. (Inst. of Nuclear Research, Swierk, Poland). Kernenergie; 13: 347-55(Nov 1970).

Two spectral codes are described. Both are written in ALGOL for the GIER computer and require a magnetic-tape drive for the cross-section library tape. The first code is based on the 26-group Russian cross-section library elaborated by Abagian, Bazazyants, Bondarenko, and Nikolayev and prepares the 26-group macroscopic constants in a form suitable for direct use in the one-dimensional criticality codes. The second code is the ALGOL version of BIGG code working previously in FORTRAN for the CDC-3600 computer. The program applies the B_1 or P_1 approximation with Greuling–Goertzel slowing-down treatment. It uses a 40-group cross-section library. The output consists of multigroup flux, leakage, and slowing-down spectra; elementwise absorption and production; few-group diffusion constants; and criticality parameters. Each code is provided with a supplementary program preparing the library tape and producing the printout of the library. (auth)

25623 SINGLY SCATTERED NEUTRON FLUX FROM A POINT SOURCE IN AN INFINITE MEDIUM. Drozhzhinov, Yu. N.; Moskalev, O. B. (Inst. of Applied Mathematics, Moscow). Dokl. Akad. Nauk SSSR; 193: 1271-3(21 Aug 1970). (In Russian).

Numerical solution of the slowing down of neutrons by the differential or Monte Carlo method makes it necessary to separate the singly scattered neutron flux. As an extension of this, an analytical expression was derived to determine the singly scattered neutron flux emitted by a monoenergetic point source in a homogeneous infinite medium. The calculation yielded also asymptotic formulas for the numerical calculation of the functionals of the flux by determining the transfer operator. The specific characteristics of the solution of the transfer equation were determined by the first integrations on the basis of collisions. Laplace's method was used to derive the asymptotic formulas. (TTT)

25624 MAXIMUM EIGENVALUE OF THE TRANSPORT OPERATOR IN A FISSIONBLE MEDIUM. Rodriguez, Pablo J. (Instituto Venezolano de Investigaciones Cientificas, Caracas); Nguyen, Dong H. J. Math. Anal. Appl.; 33: 43-51(Jan 1971).

It has been shown that the spectrum of the transport equation is made up of a finite number of eigenvalues plus the continuum. The discrete spectrum of the transport operator for the initial value problem arising in pulsed neutron studies has been shown to be bounded from below. It is shown here that the upper bound of the discrete spectrum does exist and is the fundamental decay constant. (R.W.R.)

25625 NEUTRON GENERATOR INCLUDING AN ION SOURCE WITH A MASSIVE FERROMAGNETIC PROBE ELECTRODE AND A PERMANENT MAGNET-ELECTRODE. Frentrop, Arthur H. (to Schlumberger Tech. Corp.). U. S. Patent 3,546,512. 8 Dec 1970. Filed 13 Feb 1967.

A permanent magnet is outgased for use in a controlled atmosphere by heating a ferromagnetic material to a temperature at which an irreversible loss of remanence takes place, but below the temperature at which material effects substantially reduce or remove all remanence without further special heat treatment. Gases emitted from the heated surfaces of the magnet then are evacuated. Permanent magnetic properties are not destroyed by this heat treatment, and a magnetic field of substantial strength subsequently is produced by magnetizing the outgased material. A specific embodiment of the invention enables a hollow cylindrical ion-source magnet to be placed within the envelope of a small neutron generator to provide both a magnetic field and an ion source electrode. The assembled generator then is outgased and sealed. Subsequent magnetization enables the electrode to produce the high-intensity magnetic field needed for ion generation. (auth)

XUM

25626 ASYMPTOTIC NEUTRON DISTRIBUTION IN A FINITE CYLINDER. Takeda, Toshikazu; Sekiya, Tamotsu (Osaka Univ.). J. Nucl. Sci. Technol. (Tokyo); 8: 133-40(Mar 1971).

Calculations have been performed on the asymptotic angular neutron flux, critical thickness, and extrapolation distance in the axial direction for a cylindrical system of finite length. Neutrons are assumed to be monoenergetic. Applying the finite Laplace transformation in the axial direction and buckling approximation in the radial, a solution of the transport equation is found that satisfies the boundary conditions of no incoming neutron and symmetry. This method is an extension of Kobayashi's Laplace transform method for slab problem, and may easily be applied to other geometries. For a rectangular prism system, numerical results based on the method are compared with results from P_3-approximation. (auth)

Nuclear Properties and Reactions, A≤ 5

Refer also to abstract 25654.

25627 (LA-4596) POLARIZATION EFFECTS IN NEUTRON-HELIUM SCATTERING AND THE T(d,n)^{4}He REACTION. Broste, William B. (Los Alamos Scientific Lab., N. Mex.). Jan 1971. Contract W-7405-eng-36. 154p. Dep. NTIS.

A series of experimental studies of n-^{4}He scattering and the T(d,n)^{4}He reaction were undertaken with the object of obtaining a clearer understanding of the role of spin dependent forces in the reaction. The studies of n-helium scattering involved measurements of the polarization function in the scattering for incident neutron energies of 11.0, 17.7, 23.8, 25.7, 27.3, and 30.3 MeV. The measurements were used to derive more accurate values for the polarization analyzing power of n-α scattering, in order that the polarization of the neutrons from the T(d,n)^{4}He reaction could be determined with greater certainty. Also, the n-helium polarization functions provide information on the spin-orbit effects in the outgoing channel of the reaction. Single-energy phase-shift analyses of available n-helium scattering data were made for each of the six energies, and suggestions for the modification of previously published phase shifts are given. The studies of the T(d,n)^{4}He reaction involved the determination of various polarization parameters for the reaction. Measurements were made at deuteron energies of 7.0 MeV and 11.4 MeV of the following quantities: polarization of the outgoing neutrons for unpolarized deuterons incident; polarization of the outgoing neutrons for polarized deuterons incident; and vector and tensor analyzing powers for polarized deuterons. In addition, the polarization transfer coefficient P_y^y was measured at zero degrees for deuteron energies of 3.9, 7.0, 9.0, 11.4, 13.0, and 15.0 MeV. These measurements provide information on a new source of polarized neutrons. Several lines of theoretical interpretation are pursued. The derivative rule of Rodberg is found to give a good account of d-t and n-He elastic scattering polarizations and lends strong support to the argument for large spin-orbit effects in the T(d,n)^{4}He reaction. Derivative-rule interpretation of vector-analyzing-power data is not as satisfying, but it does present some evidence for importance of d-t spin-orbit forces. DWBA calculations using optical potentials that qualitatively reproduce elastic channel data are presented. These calculations duplicate certain features of the reaction cross section, but they fail to represent the T(d,n)^{4}He neutron polarizations. The results indicate a need for the inclusion of mechanisms which can produce neutron spin-flip. Portions of the polarized beam data are interpreted within the framework of the non-dynamical formalism of Gammel, Keaton, and Ohlsen. There is clear evidence in the data that spin-flip mechanisms dominate the reaction over much of the angular range. (auth)

25628 (RPI-328-221) MeV TOTAL NEUTRON CROSS SECTION PROGRAM AT R. P. I. Stoler, P.; Yergin, P. F.; Clement, J. C.; Goulding, C. G.; Fairchild, R. (Rensselaer Polytechnic Inst., Troy, N. Y.). [nd]. Contract AT(30-1)-328. 7p. (CONF-710301-9). Dep. NTIS.

From 3. conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The MeV neutron total cross section program at the Rensselaer Linac is described, and the results of some of measurements on H, ^{23}Na, and ^{60}Ni are indicated. (auth)

25629 (UCD-CNL-125) ANNUAL REPORT, AUGUST 1, 1969-JULY 31, 1970. Jungerman, John A.; True, William W. (California Univ., Davis. Crocker Nuclear Lab.). 1 Sep 1970. Contract AT(11-1)-Gen-10. 92p. Dep. CFSTI.

CARBON-12—proton reactions (p,^{6}Li) at 45 MeV, differential cross section for, (E)
DEUTERIUM—proton reactions (p,2p) at 15 to 50 MeV, energy dependence of quasi-free scattering in, (E)
HELIUM-3—proton elastic scattering at 18 to 40 MeV, phase-shift analysis of, (E)
HYDROGEN—neutron scattering at 24 to 60 MeV, cross section for, (E)
KRYPTON-76—energy-level scheme from (α,xn) reactions, model analysis of, (E/T)
KRYPTON-78—energy-level scheme from (α,xn) reactions, model analysis of, (E/T)
KRYPTON-80—energy-level scheme from (α,xn) reactions, model analysis of, (E/T)
KRYPTON-82—energy-level scheme from (α,xn) reactions, model analysis of, (E/T)
KRYPTON-84—energy-level scheme from (α,xn) reactions, model analysis of, (E/T)
LEAD-200—energy-level scheme from (α,2n) reactions, (E)
LEAD-202—energy-level scheme from (α,2n) reactions, (E)
LEAD-204—energy-level scheme from (α,2n) reactions, (E)
LEAD-206—energy-level scheme from (α,2n) reactions, (E)
MERCURY-198—alpha reactions (α,2nγ) at 30 MeV, γ spectra from, (E)
RADIATION DETECTORS, SEMICONDUCTOR (SILICON)—peak-to-tail ratio of lithium-drifted, for protons, deuterons, helium-3, and alpha particles (J.W.R.)

25630 FAST NEUTRON DIFFERENTIAL ELASTIC SCATTERING CROSS SECTIONS FOR DEUTERIUM. Cooper, John Raymond. Auburn, Ala.; Auburn Univ. (1970). 79p. University Microfilms Order No. 71-4005.

Thesis.

The relative differential cross section for the elastic scattering of neutrons by deuterons was measured for neutron energies of 6.16, 5.91, 5.66, 5.57, 5.16, and 4.65 MeV. The neutron source utilized the ^{2}D(d,n)^{3}He reaction. Scattering took place in a deuterated benzene scintillator, and the scattered neutrons were detected in a liquid scintillator. Flight times of the neutrons were measured from the deuteron recoil pulses in the scatterer and the proton recoil pulses in the detector. Additional neutron-gamma discrimination was provided by means of electronic pulse shape selection. Corrections were made for relative efficiency of the detector and multiple interaction losses in the scatterer. The data were normalized to a previous measurement of the absolute differential cross section. (Diss. Abstr. Int., B)

25631 p-^{3}He AND p-^{3}H ANGULAR CORRELATIONS FROM THE REACTION D(^{3}He,p). Lin, Wen-kuan; Scheibling, F. (California Inst. of Tech., Pasadena). Phys. Rev., C; 3: 20-7(Jan 1971).

Protons emitted from the bombardment of deuterium with a 16.5-MeV ^{3}He beam have been measured at $\theta_p = 30°$, in coincidence with the other charged particles from the reaction. Angular correlations at $6.6 \leq E_p \leq 7.8$ MeV have been obtained and compared with a modified-Born-approximation calculation of the ^{3}He stripping. The angle-energy correlation and the p-^{3}H to p-^{3}He branching ratio can be reproduced if the ^{3}H + p phase shifts of Meyerhof and McElearney and the ^{3}He + n phase shifts of Bransden, Robertson, and Swan are used to describe the respective interactions in the final states. In agreement with Barit et al., the triplet s-wave ^{3}He + n phase shifts are found to be negative. (auth)

25632 NEUTRON SPECTRA FROM THE 38.8-MeV ALPHA-PARTICLE BOMBARDMENT OF DEUTERIUM. Lewis, C. W.; Saylor, D. P.; Northcliffe, L. C. (Texas A and M Univ., College Station). Contract AT(40-1)-3398. Phys. Rev., C; 3: 28-35(Jan 1971).

The energy spectra of neutrons from the α-particle bombardment of deuterium at 38.8 MeV have been measured at lab angles of 15, 18, 21, 24, 30, 45, and 54°. Prominent features of the spectra are explainable on simple kinematic bases. The shapes of the energy spectra and the cross-section values are consistent with the calculations of Shanley and Nakamura but seem to be inconsistent with proton spectra from the same reaction as measured by Nagatani, Tombrello, and Bromley. (auth)

25633 THEORY OF NEUTRON-DEUTERON BREAK-UP AT 14.4 MeV. Cahill, R. T.; Sloan, I. H. (Univ. of New South Wales, Kensington, Australia). Nucl. Phys.; A165: 161-79(1971).

Numerical calculations of proton spectra for three separable potential models of the three-body break-up reaction n + d → n + n + p at a neutron laboratory energy of 14.4 MeV are reported. The first (the YY model) is that used by Aaron and Amado, but with

somewhat different results. The second (the YT model) replaces the Yamaguchi form factor for the singlet nucleon-nucleon interaction by that proposed recently by Tabakin. Both the YY and YT models assume charge independence, and have a singlet n-p and n-n scattering length of −24 fm. The third model (YYY) abandons the charge independence of the YY model, and has singlet n-p and n-n scattering lengths of −24 and −16 fm respectively. The three models are compared with experiment, with particular emphasis on the n-n final-state interaction region. (auth)

25634 TOTAL NEUTRON CROSS SECTIONS OF CHEMICAL BOUND PROTONS AND DEUTERONS IN SOME METAL HYDRIDES AND DEUTERIDES. Brand, K. (Univ., Kiel). Atomkernenergie; 17: 113-20(Mar 1971). (In German).

Total neutron cross-section measurements were made of metal hydrides and deuterides using a crystal spectrometer with good energy resolution and good statistics. In contrast with the well-known hydrides (zirconium and titanium hydrides) the cross-section curves for the hydrides of the elements of the Va group (V, Nb, Ta) always show a splitting of the optical levels into two well-separated excited states. This doublet structure is believed to arise from splitting in the optical band into transverse and longitudinal modes. For vanadium hydride the cross-section curves show only broad humps; this result indicates a broad optical-phonon spectrum within the hydride lattice, which can not be resolved further. Measurements of the corresponding deuterides show similar effects. In titanium and yttrium hydrides, in which chemical bonding is relatively isotropic, the predicted structure with discrete and sharp energy levels is observed. High-temperature measurements of titanium hydride clearly show the effect of loosening in the binding forces. (auth)

25635 INFLUENCE OF HYDROGEN BONDS ON THE HYDROGEN CROSS SECTION IN THE SOLUTIONS OF SOME LIQUIDS. Suszkin, A. Atomkernenergie; 17: 121-3(Mar 1971).

The results of measurements of the hydrogen cross section in the solutions of some liquids are communicated. No conclusion can be made yet about possible influence of hydrogen bonds on the hydrogen cross section. (auth)

25636 INVESTIGATION OF A POSSIBLE BROAD THREE-NEUTRON STATE BY MEANS OF THE REACTION ^{3}H(n,p)3n. Benoehr, H. C. (Univ., Tuebingen, Ger.). Phys. Lett.; 34B: 448-50(29 Mar 1971).

The proton spectrum is calculated for the reaction ^{3}H(n,p)3n in forward direction for 30 and 50 MeV neutron energy. It is found that the broad three-neutron resonance discussed in a previous paper should give a significant deviation from the phase space background. (auth)

25637 SCATTERING OF POLARIZED NEUTRONS AT 2.7 TO 2.9 MeV ON CARBON. Haensgen, H.; Nitzsche, M. (Technische Univ., Dresden). Nucl. Phys.; A165: 401-4(1971). (In German).

The asymmetry of neutrons (2.7 to 2.9 MeV) emitted from the reaction ^{2}H(d,n)^{3}He at 50°_{lab} and scattered by carbon at 50°_{lab} was measured. The result of the present experiment indicates that the analyzing power of ^{12}C in this energy region is influenced by the $^{1}/_{2}^{+}$ and $^{5}/_{2}^{-}$ states at 7.49 and 7.55 MeV of the ^{13}C nucleus. The anomaly in the asymmetry of neutrons near E_d = 100 keV reported earlier is caused by the property of the analyzer and is not a property of the source reaction. (auth)

Nuclear Properties and Reactions, 6≤A≤19

Refer also to abstracts 23837, 23846, 25393, 25455, 25465, 25629, 25637, 25663, 25674, 25686, 25704, 25709, 25722, 25747, and 25783.

25638 (CEA-R-4133) THE STUDY OF THE REACTIONS ^{12}C + t AT ENERGIES BETWEEN 0.5 AND 1.2 MeV. Pornet, Jacqueline; Ulpat, Jean-Pierre; Bertrand, Francoise (Commissariat a l'Energie Atomique, Limeil-Brevannes (France). Centre d'Etudes). Feb 1971. 25p. (In French). Dep. NTIS (U. S. Sales Only).

Angular distributions and absolute cross sections for the ^{12}C(t,p)^{14}C (ground-state) reaction and the ^{12}C(t,α)^{11}B (ground-state and first-excited-state) reactions were measured for triton energies between 0.5 and 1.0 MeV. Excitation curves show pronounced resonances corresponding to the 15.40- and 15.75-MeV excited levels of the ^{15}N compound nucleus. (France)

25639 (COO-1051-45) THEORETICAL STUDY OF ELASTIC AND INELASTIC PION-^{12}C SCATTERING AT INTERMEDIATE ENERGIES. Lee, H. K. (California State Coll., Dominguez Hills); McManus, H. (Michigan State Univ., East Lansing). [1970]. 27p. Dep. NTIS.

Elastic and inelastic cross sections are computed using the distorted wave impulse approximation. The WKB method and a modified distorted wave code are compared. As input, pion-nucleon phase shifts, nucleon density from electron scattering, and microscopic inelastic form factors are used. It is found that the interaction given by the impulse approximation gives a fair fit to the elastic data and that the WKB approximation compares remarkably well with the distorted wave calculation at all but the lowest energies. The microscopic form factors of the 2^{+} level at 4.4 MeV and 3^{-} level at 9.6 MeV give a good account of the inelastic scattering. Discrepancies in the elastic scattering are similar to those observed in 1-GeV proton scattering from carbon. (auth)

25640 (ITF-70-87-P) MULTIPOLE ANALYSIS OF THE POLARIZATION PHENOMENA AT THE FAST NUCLEON SCATTERING BY NUCLEI. Sitenko, A. G.; Fursa, A. D. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1970. 15p. (In Russian). Dep. NTIS (U. S. Sales Only).

Polarization and asymmetry from elastic and inelastic nucleon scattering by ^{12}C with distortion due to the spin−orbit interaction taken into account are considered on the basis of the multipole formalism developed earlier for describing nucleon scattering by nuclei. The optical potential and its parameters are obtained from the nucleon−nucleon interaction in accordance with multipole scattering theory. The numerical calculations and comparison with experimental data are carried out for the elastic scattering as well as for inelastic proton scattering with the excitation of the $2^{+}T$ = 0(4.44 MeV) and $3^{-}T$ = 0(9.64 MeV) states of ^{12}C. (auth)

25641 (JINR-P15-5524) NEUTRON YIELD IN THE μ CAPTURE REACTION ON OXYGEN, SULFUR, CALCIUM, AND LEAD. Voitkovska, L.; Evseev, V. S.; Kozlovski, T.; Mamedov, T. N.; Roganov, V. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1970. 14p. Dep. NTIS (U. S. Sales Only).

An absolute μ-capture neutron yield (per μ-capture event) was measured in oxygen, sulfur, calcium, and lead in the energy regions of 2.5 to 7.5 MeV (n = 0.526 ± 0.0968), 1.5 to 10 MeV (n = 0.414 ± 0.035), 2 to 10 MeV (n = 0.263 ± 0.033), and 2 to 7 MeV (n = 0.536 ± 0.031), respectively. In μ-capture in oxygen there is a quantitative agreement between the neutron yield value obtained and the resonance model prediction on the nuclear μ-capture. (auth)

25642 (NYO-2171-336) EQUIVALENCE OF ^{3}He-t AND d-α CLUSTER DESCRIPTION OF ^{6}Li. Amado, R. D.; Noble, J. V. (Pennsylvania Univ., Philadelphia. Dept. of Physics). 8 Jan 1971. 5p. Dep. NTIS.

The equivalence, rather than the mutual exclusion, of the ^{3}He−t and d−α descriptions of ^{6}Li is pointed out. (auth)

25643 (RLO-1388-597) QUADRUPOLE SURFACE OSCILLATIONS AND THE ELASTIC FORM FACTOR OF ^{16}O AND ^{12}C. Friar, J. L. (Washington Univ., Seattle. Dept. of Physics). Sep 1970. 20p. Dep. NTIS.

By using a volume-conserving liquid-drop model for quadrupole surface oscillations, the elastic form factors for ^{16}O and ^{12}C were calculated. It is shown that zero-point oscillations of the quantized drop produce an effective charge density which differs from that of the uniform, unquantized drop by having a reasonable skin thickness. The resulting elastic form factors are in reasonable agreement with recent experimental data. The transition density for exciting the lowest quadrupole state in this model is shown to be the same as that of Tassie's hydrodynamical model. (auth)

25644 STUDY OF ^{8}Li RECOIL NUCLEI IN REACTION ^{9}Be(p,2p)^{8}Li AT 180 AND 660 MeV PROTONS. Grigor'ev, E. L.; Lozhkin, O. V.; Marich, Z.; Susienko, V. K.; Kochkin, V. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 12: 903-12(Nov 1970). (In Russian).

Differential energy spectra and angular distributions of ^{8}Li recoil nuclei produced in the reaction ^{9}Be(p,2p)^{8}Li at 180 and 660 MeV were studied. To detect ^{8}Li, nuclear photoemulsions were used. The experimental results are compared with the calculations made in the impulse approximation. (auth)

25645 ELASTIC SCATTERING OF 50 MeV PROTONS BY LIGHT NUCLEI. Mani, G. S.; Jacques, D.; Dix, A. D. B. (Univ. of Manchester, Eng.). Nucl. Phys.; A165: 145-51(1971).

Differential cross-section and polarization measurements have been made for elastic scattering of 50-MeV protons by ^{6}Li, ^{7}Li, and ^{9}Be. An optical-model analysis of the data is presented. The parameters of the optical-model potential obtained compare reasonably well with those obtained for heavier nuclei. (auth)

XUM

25646 INVESTIGATION OF THE LOW-LYING STATES IN ^{6}Li BY INELASTIC ELECTRON SCATTERING. Neuhausen, R.; Hutcheon, R. M. (Univ., Mainz). Nucl. Phys.; A164: 497-512 (1971).

The inelastic electron scattering cross sections for the excitation of the low-lying states of ^{6}Li have been measured in the momentum transfer region q = 0.7 – 1.8 fm^{-1}, with emphasis on the transverse transitions to the 3.56 and 5.36 MeV T = 1 states. The intermediate coupling shell-model wave functions both in these states and in the ground state have been determined using radial wave functions generated in finite potentials. The form factors, especially the form factor for the M1 transition to the 3.56 MeV state, are sensitive to the radial distribution of the outer nucleons in ^{6}Li. The form factor and nucleon distribution of the four ^{6}Li core nucleons relative to the nuclear center of mass have been deduced from the well-known elastic charge form factor and fitted to a Gaussian shape. (auth)

25647 α-PARTICLE MODEL OF ^{16}O. Bertsch, G. F. (Princeton Univ., N. J.); Bertozzi, W. Contracts AT(30-1)-2098; AF 49 (638)-1545. Nucl. Phys.; A165: 199-210(1971).

A simple α-particle model is constructed for ^{16}O. By making suitable approximations on the wave function of four interacting particles, the Schrödinger equation is reduced to a one-dimensional equation. The equation is solved using empirical α-α interactions. Reasonable agreement with experiment is obtained on the radius of the ground state, and the energies of the ground and first excited 0^{+} states. The model qualitatively explains the predominantly deformed structure of the excited state, and the mixing of a deformed component into the ground state. The value obtained for the mixing is somewhat too large. (auth)

25648 TETRAHEDRAL DEFORMATION IN THE NUCLEUS ^{16}O. Onishi, N.; Sheline, R. K. (Florida State Univ., Tallahassee). Nucl. Phys.; A165: 180-98(1971).

The tetrahedrally deformed model is applied to the excited states in the ^{16}O nucleus. Single-particle spectra and wave functions are calculated using a tetrahedrally deformed potential. The intrinsic energy for ^{16}O is determined as a function of the depth of the tetrahedrally deformed potential assuming the nuclear force has a soft core. Vibration and deformation which break the tetrahedral symmetry are discussed. (auth)

25649 THE 1.67 MeV LEVEL IN ^{9}Be. Tucker, S. N. (Australian National Univ., Canberra); Treacy, P. B.; Komarov, V. V. Aust. J. Phys.; 23: 651-4(1970).

A study has been made of the 1.67-MeV level in ^{9}Be using 6.0-MeV protons to populate it via the ^{9}Be(p,p')^{9}Be* reaction. The spectrum of protons inelastically scattered at a 90° laboratory angle was fitted with a line shape based on R-matrix theory. The position of the line-shape peak above the ^{8}Be + n threshold is $25^{+}_{-}{}^{+}_{-}$ keV; this value and deduced level parameters are in disagreement with recent results from a similar fit to the ^{9}Be(γ,n)^{8}Be reaction. (auth)

25650 ELASTIC SCATTERING OF DEUTERONS POSSESSING 13.6 MeV ENERGY BY LIGHT NUCLEI. Vereshchagin, A. N.; Korostova, I. N.; Chernov, I. P. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 105-13(1970). (In Russian).

Differential cross sections for elastic deuteron scattering at 13.6 MeV were measured for nineteen nuclei from Be to Fe and for inelastic scattering for the excited lower levels of Be, C, ^{46}Ti, and ^{48}Ti. A series of singularities uncovered in the angular distributions were related to the Coulomb and nuclear scattering. Data obtained for the angular distribution were analyzed on the basis of the nuclear optical model. The model explains deuteron inelastic scattering satisfactorily. (tr-auth)

25651 AN EXPERIMENTAL STUDY OF THE ^{14}N(p,pd)^{12}C (g.s.) AND ^{14}N(p,pd)^{12}C (4.4 MeV) QUASI-ELASTIC REACTIONS AT 46 MeV. Welch, L. C. (Univ. of Southern California, Los Angeles); Chang, C. C.; Forster, H. H.; Kim, C. C.; Devins, D. W. Lett. Nuovo Cim.; 1: 25-9(2 Jan 1971).

After a general introduction to the subject of quasi-elastic scattering, the utility of the ^{14}N(p,pd)^{12}C reaction for obtaining information on the structure of the nucleus ^{14}N is discussed. Protons of 46 MeV bombarded a 99.999% ^{14}N gas target, and coincident deuterons and protons were detected at angles from 20 to 75°. Typical energy spectra are given, as well as the differential cross sections for ground and 4.4-MeV states in ^{12}C. It is concluded that a nonnegligible component in the structure of ^{14}N in the ground state is a deuteron coupled to a ^{12}C core in the ground or first excited state. This deuteron is in an L ≠ 0 state relative to the core (probably in a $^{3}D_{1}$ state). (R.W.R.)

25652 ELECTRODISINTEGRATION OF LIGHT NUCLEI. Sitenko, A. G.; Pasichnii, A. A.; Tartakovskii, V. K. (Inst. of Theoretical Physics, Kiev). Yadern. Fiz.; 12: 1208-17(Dec 1970). (In Russian).

Electrodisintegration is considered, i.e., inelastic electron scattering by nuclei with emission of nucleons. The case of ultrarelativistic electrons and light nuclei is investigated. The Coulomb and magnetic interactions of electrons with the nucleons are taken into account. Exact solutions of the Schroedinger equation with the Woods–Saxon potential are used as the nucleon wave functions in the initial and final states. Numerical calculations are carried out for the electrodisintegration cross section of the ^{12}C nucleus. The effect of distortion of the final nucleon wave is investigated. It is shown that by calculating with such one-particle functions, one succeeds in obtaining agreement both in positions of the maxima and in the shape of the momentum distributions for electrodisintegration of light nuclei. (auth)

25653 OBSERVATION OF THE FORBIDDEN α DECAY OF ^{12}C NUCLEUS FROM THE STATE WITH ENERGY OF 15.1 MeV. Artemov, K. P.; Goldberg, V. Z.; Petrov, I. P.; Rudakov, V. P.; Serikov, I. N. Yadern. Fiz.; 12: 1108-16(Dec 1970). (In Russian).

Isospin-forbidden α decay of the ^{12}C nucleus from the state with energy of 15.1 MeV (1^{+}, T = 1) which has not been observed before, was detected. The α-decay width of the state is bound to be Γ_{α} = 2.3 ± 0.9 eV. The α-decay width of the 12.7-MeV state (1^{+}, T = 0) is estimated; the result is $\Gamma_{\alpha} \approx 6$ eV. The consequence is that the small α-decay width of the 15.1 MeV state is due not to the high isospin purity of the state but to the small α-decay width of the mixing configuration. (auth)

25654 ELECTROPRODUCTION OF SLOW PIONS ON NUCLEI AND GIANT RESONANCE VIBRATIONS. Eisenberg, J. M.; Weber, H. J. (Univ. of Virginia, Charlottesville). Phys. Lett.; 34B: 107-9(1 Feb 1971).

The (e,e'π) reaction at high momentum transfer on light nuclei is shown to excite $J^{\pi} = 0^{-}$ spin–isospin vibrations preferentially; therefore, they are able to be observed experimentally. (auth)

25655 WIDTH OF THE 2.9 MeV STATE IN ^{9}Be FROM THE ^{7}Li(d,n)^{9}Be REACTION. Roy, R.; Birchall, J.; Slobodrian, R. J. (Univ. Laval, Quebec). Phys. Lett.; 34B: 491-3(29 Mar 1971).

Experimental results on the ^{7}Li(d,n)^{8}Be reaction at 3.72 and 4.76 MeV bombarding energy, and previous results at lower energies, are successfully interpreted in terms of a two-body final-state interaction in a three-body system, resolving an existing discrepancy between two-body phase shifts (or parameters) and the width of the neutron peak. (auth)

25656 ISOSPIN PURITY OF THE T = 1 STATES IN ^{6}Li. Debevec, P. T.; Garvey, G. T.; Hingerty, B. E. (Princeton Univ., N. J.). Phys. Lett.; 34B: 497-9(29 Mar 1971).

A study of the relative cross sections of the analog reactions ^{7}Li(d,t)^{6}Li and ^{7}Li(d,^{3}He)^{6}He shows that the two lowest T = 1 levels in ^{6}Li have high isospin purity ($\alpha^{2} < 0.008$). Additional confirmation of high degree of isospin purity comes from an examination of the wave functions involved. (auth)

25657 POLARIZATION IN ^{3}He ELASTIC SCATTERING AND THE ^{3}He SPIN-ORBIT POTENTIAL. England, J. B. A.; Harris, R. G.; Watson, L. H.; Worledge, D. H. (Univ. of Birmingham, Eng.). Nucl. Phys.; A165: 277-88(1971).

Measurements by a double scattering technique are reported on the polarization produced in the elastic scattering at 25° lab, of ^{3}He particles of energies between 30.5 and 31.6 MeV from natural targets of beryllium, carbon, aluminium, titanium, and copper. The observed polarizations are very small. Optical-model analysis of these results in conjunction with the angular distributions for elastic scattering of ^{3}He from these targets allows an upper limit to be set on the spin-orbit potential. It is found that a spin-orbit potential of less than 5 MeV is consistent with all the data, with a possible preferred range of 3 to 4 MeV. (auth)

25658 (d,^{6}Li) REACTIONS ON p AND sd SHELL NUCLEI AND THEIR INTERPRETATION BY FINITE-RANGE DWBA. Gutbrod, H. H.; Yoshida, H.; Bock, R. (Max-Plack-Institut fuer Kernphysik, Heidelberg. Univ., Marburg, Ger.). Nucl. Phys.; A165: 240-58(1971).

The (d,^{6}Li) reaction on ^{10}B, ^{11}B, ^{12}C, ^{16}O, ^{19}F, ^{28}Si, and ^{40}Ca has been investigated with the 19.5-MeV deuteron beam of the MPI Emperor tandem Van de Graaff. The measured angular distributions are analyzed by finite-range DWBA calculations. Spectroscopic factors for the α-cluster transfer have been calculated from shell-model wave functions for the target nuclei. The theoretical cross sections are found to be very sensitive to the choice of the model for ^{6}Li. The cluster model leads to cross sections which are strongly enhanced compared to the shell-model predictions. They reproduce the absolute experimental cross sections

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of the ground state transitions for the target nuclei from ^{12}C to ^{48}Ca. However, the experimental (d,^{6}Li) cross section on the ^{10}B target is much larger than predicted and the angular distribution cannot be described. This indicates a more complicated reaction mechanism in this case. (auth)

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Refer also to abstracts 23837, 25460, 25628, 25629, 25641, 25650, 25657, 25658, 25703, 25704, 25709, 25725, 25731, 25747, 25767, 25769, 25771, 25783, and 25829.

25659 (AE-410, pp 83-9) APPLICATIONS OF MASS SPECTROMETRY ON He IN SOLIDS TO ANALYSIS, NUCLEAR PHYSICS AND MATERIALS TECHNOLOGY. (Aktiebolaget Atomenergi, Studsvik (Sweden)).

From General Physics Section progress report, fiscal year 1969-70.

Fast-neutron helium production cross section measurements, a boron analysis method, and development work on helium-accumulating dosimeters for high neutron fluences and long irradiation times are briefly described. Results from studies of anomalous helium production in nickel are given. (Sweden)

25660 (ANU-P-498) TENSOR POLARIZATION OF DEUTERONS FROM THE Mg(d,d)Mg ELASTIC SCATTERING AT 7.0 MeV. Djaloeis, A.; Nurzynski, J. (Australian National Univ., Canberra. Dept. of Nuclear Physics). [1969]. 21p. Dep. NTIS (U. S. Sales Only).

The spin tensor moments $\langle T_{20} \rangle$, $\langle T_{21} \rangle$, and $\langle T_{22} \rangle$ of deuterons emitted from the Mg(d,d)Mg elastic scattering reaction were measured. The average deuteron energy ($\bar{E}_d$) at the center of the effective target thickness was 7.0 MeV. The angular dependence of the deuteron tensor polarization was obtained for angles between 15° and 90° (lab) in steps of 7.5°. Optical model analyses without and with the inclusion of the Hauser-Feshbach theory were performed. In all cases, combinations of central potential with spin-orbit interaction were found inadequate to reproduce the data. The addition of a small attractive and long-ranged tensor interaction T_R resulted in a considerably improved fit. Inclusion of a T_I tensor interaction was redundant. (auth) (Australia)

25661 (ANU-P-509) THE DECAY OF ^{45}Ti TO ^{45}Sc. Zuk, W. M.; Davidson, W. F.; Najam, M. R.; Awal, M. A. (Australian National Univ., Canberra. Dept. of Nuclear Physics). [1970]. 9p. Dep. NTIS (U. S. Sales Only).

The low-intensity β^+/E.C. branches in the decay of ^{45}Ti to excited states of ^{45}Sc were re-investigated in order to resolve discrepancies in reported branching ratios. A new branch to the 974-keV level, having an intensity of $9.9 \pm 1.2 \times 10^{-5}$/decay, was found. A previously reported branch to the 1237-keV level was found to be in error. The intensities for decay to the levels at 720, 1408, and 1661 keV were determined to be 154 ± 12, 90.2 ± 9.7, and 52.5 ± 5.6, respectively, in units of 10^{-5} per decay. (auth) (Australia)

25662 (JAERI-Memo-4191) THERMAL NEUTRON SCATTERING FROM SIMPLE LIQUID METALS. Nakahara, Yasuaki (Japan Atomic Energy Research Inst., Tokyo). Oct 1970. 84p. Dep. NTIS (U. S. Sales Only).

A new phenomenological method is proposed to calculate double differential scattering cross sections for thermal-neutron scattering from simple monatomic liquid metals such as liquid sodium. A general expression for coherent part of the cross section has been obtained from a system of classical Vlasov equations (collisionless kinetic equations) for fully ionized ions and electrons interacting with each other through Coulomb or effective potentials. An effective potential is derived using the second moment theorem for the scattering law $S(\vec{\kappa},\omega)$. The Coulomb and effective potentials give almost the same $S(\kappa,\omega)$. Comparison between our ion-electron model and Nelkin-Ranganathan's neutral-atom model shows that the explicit consideration of charges of ions and the existence of conduction electrons gives an excellent improvement. The gross structure of the reduced scattering law is determined by incoherent scattering. The incoherent part of the scattering law has been calculated with the GASKET/J code, which is a revised version of the GASKET code. The reduced scattering law $S_R(\kappa,\beta)$ is given by the combination of $S(\kappa,\omega)$ and $S_s(\kappa,\omega)$. The calculated $S_R(\kappa,\beta)$ for liquid sodium shows an excellent qualitative and quantitative agreement with experimental values, except for β's around 1.0 (where energy transfer is comparable to the energy of thermal motion of ions). The best agreement is seen for $S_R(\kappa,\beta)$, coherent part of which has been calculated from the quasi-quantum treatment (in which are used the classical Vlasov equation for ions, the Balescu equation for electrons and the effective potential). (Japan)

25663 (LYCEN-7071) USE OF THE NILSSON MODEL FOR STUDYING SOME NUCLEI OF THE 2s-1d SHELL. Midy, Pierre (Lyon Univ. (France). Institut de Physique Nucleaire). Oct 1970. 94p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The unified Bohr-Mottelson model was used to interpret the first excited levels of the deformed nuclei ^{21}Ne, ^{21}Na, and ^{23}Ne. A comparison was made between these results and those obtained for neighboring odd nuclei with the same number of nucleons ^{23}Na, ^{23}Mg, ^{19}O(Z or N = 11), ^{25}Al, ^{25}Mg, ^{27}Al, and ^{27}Si (Z or N = 13). The Bohr-Mottelson model was used without the vibrational terms and with the Nilsson potential. When Z or N = 11, the predictions of the model are in good agreement with experiment except in the case of ^{19}O, whose spectrum is not well known. The cases when Z or N = 13 were considered. Satisfactory results were obtained for ^{25}Al and ^{25}Mg. It was difficult to obtain simultaneously the quadrupole moment and energy levels of ^{25}Mg. The results for ^{23}Na were not so good, and an interpretation of the results for ^{27}Al and ^{27}Si was difficult. Agreement was good for particle states in the N = 2 shell but dubious for hole states in this shell. Excellent agreement might be obtained for hole states in the 1 p shell for the case of Z or N = 11 if a value of $1/2^-$ is unambiguously attributed to the lower level; agreement was not good for Z or N = 13. The model is consolidated by the small number of parameters used and their consistency for ^{21}Na and ^{21}Ne, ^{23}Na and ^{23}Mg, and ^{25}Al and ^{25}Mg. (France)

25664 (N-70-40560) Si(n,p) AND Si(n,α) REACTION CROSS SECTIONS AT 14.5-MeV NEUTRON ENERGY. Singh, Jag J. (National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center). Oct 1970. 21p. (NASA-TN-D-5946; L-7184). NTIS.

Measurements of cross sections for (n,p) and (n,α) reactions induced by 14.5-MeV neutrons in various isotopes of silicon are described. (auth) (STAR)

25665 (NP-18692) INTERNAL SOURCE SCINTILLATION SPECTROMETRY ON NUCLIDES DECAYING BY ELECTRON CAPTURE. Goedbloed, Willem (Vrije Universiteit, Amsterdam (Netherlands)). 20 Feb 1970. 62p. Dep. NTIS (U. S. Sales Only).

Thesis.

Orbital-electron-capture ratios and electron-capture-to-positron-emission ratios were studied with an internal source scintillation method. An account of theory is given with emphasis on the information that may be derived from these ratios. Important developments both in theory and experiment from 1963 till now are surveyed. In order to obtain significant results experimental accuracies of a few percent are required; a discussion of detectors that may fulfill these accuracy requirements is given. Since proportional counters and internal-source scintillation crystals are capable of detecting both X rays and Auger electrons, they are generally used in this field. The spectrometers used in the measurements consist of two parts, which are called source crystals and enveloping crystals, respectively. The source crystals are obtained from the melt by a crystal growing procedure. In that way the source atoms are dispersed through the volumes of the alkali halide scintillators. Various enveloping crystal constructions are investigated. The following quantities were measured: the electron-capture ratios of ^{109}Cd, ^{83}Rb, and ^{84}Rb and the electron-capture-to-positron-emission ratio of ^{84}Rb to the first excited state in ^{84}Kr. (auth)

25666 (ORNL-TM-3205) REPORT TO THE AEC NUCLEAR CROSS SECTION ADVISORY COMMITTEE. Good, W. M. (Oak Ridge National Lab., Tenn.). Dec 1970. 42p. Dep. NTIS.

This memo is a collection of brief reports on recent and not yet generally publicized work at ORNL which is of special interest to the NCSAC. Included are abstracts of relevant ORNL reports, and papers which have been only submitted for publication. The memo covers the period of time since the last NCSAC meeting. (auth)

25667 (ORO-3235-66) ^{122}In ISOMERS. Takahashi, K.; Swindle, D. L.; Kuroda, P. K. (Arkansas Univ., Fayetteville. Dept. of Chemistry). [1968]. Contract AT(40-1)-3235. 22p. Dep. NTIS.

Irradiation of enriched ^{122}Sn with 14.8-MeV neutrons was found to produce a new radioactivity with half-life of 1.5 ± 0.3 sec which was assigned to an isomer of ^{122}In. The decay of the 7.5-sec ^{122}In isomer was also studied, and a new half-life of 10.0 ± 0.5 sec was determined. (auth)

25668 (ORO-3346-65) NUCLEAR SPECTROSCOPY WITH RADIOACTIVE SOURCES AND FAST NEUTRON REACTIONS.

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Sixth Annual Progress Report, 1970. Fink, R. W. (Georgia Inst. of Tech., Atlanta. School of Chemistry). 31 Oct 1970. Contract AT(40-1)-3346. 82p. Dep. NTIS.

Research progress in nuclear spectroscopy and fast neutron reactions for the year ending Oct. 31, 1970 at the School of Chemistry of the Georgia Institute of Technology is summarized. The experimental equipment and facilities are described, and the personnel are listed. (J.W.R.)

25669 (RPI-328-222) OBSERVATION OF CORRELATIONS BETWEEN Γ_n^0 AND Γ_γ IN THE MASS RANGE 50 TO 60. Block, R. C.; Stieglitz, R. G.; Hockenburg, R. W. (Rensselaer Polytechnic Inst., Troy, N. Y.). [1970]. Contract AT(30-1)-328. 7p. Dep. NTIS.

Neutron-capture and -transmission measurements in the keV energy region on ^{50}Cr, ^{52}Cr, ^{53}Cr, ^{54}Cr, ^{51}V, and ^{60}Ni enabled 27 s-wave resonances to be analyzed for E_o, J, π, Γ_n, and Γ_γ. The correlation coefficients between the reduced neutron width and the total radiation width $\rho(\Gamma_n^0,\Gamma_\gamma)$ are $\rho = 0.47$ for all 27 resonances, $\rho = 0.38$ for the 15 resonances in the odd (target) nuclei, and $\rho = 0.80$ for the 12 resonances in the even–even nuclei. The latter value of 0.80 is beyond the 99% confidence limit for a significant correlation to exist. In addition, the resonance-capture pulse-height spectra are dominated by strong high-energy gamma rays, which are interpreted as E1 transitions. This positive correlation, coupled with the strong E1 transitions, is interpreted as evidence of intermediate structure. (auth)

25670 SPINS OF LEVELS IN ^{64}Cu. Wellborn, C. C.; Williams, R. P.; Buccino, S. G. (Tulane Univ., New Orleans). Phys. Rev., C; 3: 153-8(Jan 1971).

The method-I angular correlation technique of Litherland and Ferguson has been applied to the reaction $^{64}Ni(p,n\gamma)^{64}Cu$. Spin assignments were obtained for the following levels in ^{64}Cu: 1 (0 keV), 2 (159 keV), (1,2) (278 keV), 1 (344 keV), 3 (362 keV), and 1 (663 keV). E2/M1 mixing ratios for the 159- and 203-keV transitions were determined. A weak transition from the 362-keV level to the ground state was observed. (auth)

25671 LEVELS OF ^{44}Sc FROM THE $^{45}Sc(d,t)^{44}Sc$ REACTION. Ohnuma, H.; Sourkes, A. M. (Univ. of Minnesota, Minneapolis). Phys. Rev., C; 3: 158-67(Jan 1971). (COO–1265-91).

Energy levels in ^{44}Sc have been studied using the $^{45}Sc(d,t)^{44}Sc$ reaction at 19.5-MeV incident energy. Thirty-six levels in ^{44}Sc below an excitation energy of 3.2 MeV were observed. Angular distributions were measured and compared with the distorted-wave Born-approximation theory to obtain transferred l values and spectroscopic factors. A considerable amount of l = 1 strength was found, indicating the presence of 2p neutrons in the ground state of ^{45}Sc. A recent shell-model calculation using an $(f_{\frac{7}{2}})^4$ configuration shows qualitative agreement with experiment. (auth)

25672 γ-RAY SPECTRA MEASUREMENT FROM THE CAPTURE OF INTERMEDIATE NEUTRONS. Broder, D. L.; Gamalii, A. F.; Zemtsev, B. V.; Nesterov, B. V.; Kham'yanov, L. P. Yadern. Fiz.; 13: 3-5(Jan 1971). (In Russian).

The spectra of γ rays from the capture of intermediate neutrons in a ^{53}Cr sample are measured by means of a semiconductor Ge(Li) γ spectrometer. The spectra are given for reaction $^{53}Cr(n,\gamma)^{54}Cr$ for the capture of thermal neutrons and of neutrons with the energy of 2 keV. (auth)

25673 FERROUS-FERRIC ANOMALY IN QUADRUPOLE MOMENT OF ^{57m}Fe. Sharma, R. R. (Univ. of Illinois, Chicago). Phys. Rev. Lett.; 26: 563-5(8 Mar 1971).

The nuclear quadrupole moment Q of ^{57m}Fe was determined from the calculated electric field gradients (including all the metal-ion–ligand overlaps) and the quadrupole splitting data in Fe_2O_3 and Al_2O_3: Fe^{3+}. The values of $Q(^{57m}Fe)$ obtained in the two cases are 0.180 ± 0.015 and 0.204 ± 0.018 b, which are consistent with the values reported in ferrous compounds; this agreement disposes of the well-known ferrous–ferric anomaly. (auth)

25674 NUCLEAR FERMI MOMENTA FROM QUASI-ELASTIC ELECTRON SCATTERING. Moniz, E. J. (Stanford Univ., Calif.); Sick, I.; Whitney, R. R.; (and others). Phys. Rev. Lett.; 26: 445-8 (22 Feb 1971).

The cross sections for quasi-elastic electron scattering from nine target nuclei from lithium to lead were measured for an electron incident energy of 500 MeV and a scattering angle of 60°. The data are interpreted in terms of a Fermi-gas model; this treatment yields the nuclear Fermi momentum as a function of atomic number. The Fermi momentum increases from lithium to calcium and remains roughly constant at about 260 MeV/c from nickel to lead. (auth)

25675 ALPHA-PARTICLE SCATTERING FROM ^{20}Ne AND ^{40}Ar AT ENERGIES BETWEEN 13 AND 17 MeV. Bucurescu, D.; Ivascu, M.; Semenescu, G.; Titirici, M. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 15: 1093-1103(1970).

Elastic and inelastic scattering of alpha particles from ^{20}Ne at 13.1, 14.5, and 15.1 MeV and from ^{40}Ar at 14.5, 15.1, 16.0, and 17.1 MeV have been measured. An investigation of the applicability of the optical model and the DWBA at these energies is made. Good fits are obtained for ^{40}Ar, especially at the higher energies, whereas for ^{20}Ne the agreement between theory and experiment is poorer and deteriorates rapidly with increasing energy. (auth)

25676 HIGH RESOLUTION STUDY OF THE ENERGY LEVELS OF ^{27}Al. Doekes, C. (Univ. of Guelph, Ont.); Kean, D. C.; Elliott, R. V.; Spear, R. H. Can. J. Phys.; 49: 483-5(15 Feb 1971).

The energy levels of the nucleus ^{27}Al were studied with an energy resolution of about 6 keV by magnetic analysis of the protons from the $^{27}Al(p,p')^{27}Al$ reaction. A number of previously unreported levels were observed. (auth) (Canada)

25677 CONCERNING A POSSIBLE K = $\frac{1}{2}$ NEGATIVE PARITY BAND IN ^{29}Si. Spear, R. H.; Cairns, J. E.; Elliott, R. V.; Kuehner, J. A.; Pilt, A. A. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 49: 355-9(1 Feb 1971).

Linear polarization studies of gamma radiation from the reaction $^{26}Mg(\alpha,n\gamma)^{29}Si$ show that the parity of the 3.623 MeV $J = \frac{1}{2}$ state is negative, and that the spin and parity of the 5.255 MeV state are $\frac{5}{2}^-$ or $\frac{3}{2}^-$. A previously reported unique $J = \frac{3}{2}$ assignment for the latter state is not confirmed. (auth) (Canada)

25678 CROSS SECTIONS AND ISOMER RATIOS FOR THE ISOMERIC PAIR /sup 90m/Y AND /sup 90g/Y IN THE $^{89}Y(d,p)$ REACTION. Corazza, C.; Nassiff, S. J. (Comision Nacional de Energia Atomica, Buenos Aires). Radiochim. Acta; 15: 7-9(Jan 1971).

Excitation functions and cross section ratios for the isomeric pair ^{90m}Y and ^{90g}Y produced by the $^{89}Y(d,p)$ reaction were measured up to 27.0 MeV. The experiments were performed by the stacked-foil technique, without chemical separation of the radioactive products. (auth)

25679 STUDIES OF ^{37}Ar VIA THE $^{36}Ar(d,p\gamma)^{37}Ar$ REACTION. Champlin, J. W. (Yale Univ., New Haven); Howard, A. J.; Olness, J. W. Contracts AT(30-1)-2726; AT(30-1)-3223. Nucl. Phys.; A164: 307-20(1971).

The ^{37}Ar states below an excitation energy of 3.7 MeV have been studied via the $^{36}Ar(d,p\gamma)^{37}Ar$ reaction at deuteron bombardment energies in the vicinity of 3 MeV. Direct γ-ray spectra were recorded in Ge(Li) spectrometers at $\theta_\gamma = 0°$ and 90° with gas target pressures in the range 25 to 3000 Torr. The following excitation energies were observed for the low-lying levels of ^{37}Ar: E_x = 1408.8 ± 1.5, 1611.2 ± 0.8, 2218.2 ± 1.5, 2490.6 ± 1.3, 2796.3 ± 1.8, 3171.3 ± 1.7, 3186.4 ± 1.7, 3273.4 ± 1.6, 3516.1 ± 1.8, 3526.1 ± 2.1 and 3607.7 ± 2.9 keV. An upper limit on the mean lifetime of $\tau \leq$ 30 ps was deduced from the Doppler shift for all of the above states except the relatively long-lived 1611 keV state. Proton-gamma angular correlation studies were performed in a collinear geometry at $E_d = 2.800$, 2.975 and 3.100 MeV. The following spin restrictions resulted therefrom: $E_x(J)$ = 1611 ($\frac{5}{2}$,$\frac{7}{2}$), 2218 ($\frac{5}{2}$,$\frac{7}{2}$), 2491 ($\frac{3}{2}$, $\frac{5}{2}$), 2796 ($\leq \frac{7}{2}$), 3171 ($\frac{3}{2}$,$\frac{5}{2}$), 3273 ($\frac{3}{2}$,$\frac{5}{2}$), 3516 ($\frac{3}{2}$), 3526 ($\frac{7}{2}$), and 3608 ($\frac{3}{2}$,$\frac{5}{2}$). The results of the present and previous studies on the low-lying levels of the ^{37}Ar structure are synthesized and compared with existing shell-model calculations. (auth)

25680 LIFETIME AND g-FACTOR OF THE 273 keV LEVEL IN ^{74}As. Christiansen, J.; Mahnke, H.-E.; Recknagel, E.; Riegel, D.; Witthuhn, W. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Nucl. Phys.; A164: 367-75(1971).

Low-lying states of ^{74}As have been populated by the nuclear reaction $^{74}Ge(p,n)^{74}As$. Using a Ge(Li) detector and $\gamma\gamma$ coincidence techniques the lower part of the excited spectrum has been constructed. A new isomeric level with a half-life $T_{\frac{1}{2}} = 26.8 \pm 0.5$ ns has been observed. The g-factor of this state has been determined by the pulsed-beam differential perturbed angular distribution method (PBDPAD) to be $g = +0.807 + 0.010$. The most probable spin and parity assignment of the level is 3^+. (auth)

25681 ELECTROEXCITATION OF COLLECTIVE STATES IN ISOTOPES ^{64} ^{66}Zn. Afanas'ev, V. D.; Afanas'ev, N. G.; Buki, A. Yu.; (and others) (Physical-Technical Inst., Kharkov). Yadern. Fiz.; 12: 885-91(Nov 1970). (In Russian).

Form factors are measured for inelastic electron scattering on the nuclei $^{64,66}Zn$ for the electron energies 150 and 225 MeV, in the momentum transfer range from 0.6 up to 1.8 f^{-1}. The experimental data are analyzed using the improved Born approximation and the high-energy approximation. Reduced probabilities of E2 and E3 transitions are determined. (auth)

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25682 EXCITATION OF THE FIRST LEVELS IN NUCLEI ^{58}Ni AND ^{60}Ni. Broder, D. L.; Gamalii, A. F.; Lashuk, A. I.; Sadokhin, I. P.; Tikhonov, A. I. Yadern. Fiz.; 12: 873-4(Nov 1970). (In Russian).

By means of a semiconductor Ge(Li) detector the cross sections were measured for excitation of the first levels of ^{58}Ni (1.452 MeV) and ^{60}Ni (1.332 MeV) in inelastic scattering of neutrons with energies up to 2.20 MeV. The ratios obtained of the excitation cross sections for ^{58}Ni (1.452 MeV) and ^{60}Ni (1.332 MeV) are essentially different from unity. This result is in disagreement with the statistical model of nuclear reactions. (auth)

25683 STUDY OF MASS-3 OPTICAL MODEL POTENTIAL FOR MEDIUM-WEIGHT NUCLEI. Urone, Paul Peter. Boulder, Colo.; Univ. of Colorado (1970). 249p. University Microfilms Order No. 70-23,761.

Thesis.

The properties of the nuclear-optical-model potential used to represent the elastic scattering of mass-3 particles by medium-weight nuclei are investigated. ^{3}He elastic scattering cross sections were measured at 21.0 MeV on targets of ^{40}Ca, ^{52}Cr, ^{54}Fe, ^{62}Ni, ^{64}Ni, ^{90}Zr, and ^{118}Sn and at 37.7 MeV on targets of ^{46}Ti, ^{48}Ti, ^{50}Ti, ^{51}V, ^{58}Fe, ^{58}Ni, ^{62}Ni, ^{90}Zr, and ^{91}Zr. The ^{3}He elastic scattering cross section measurements were extended well into the backward hemisphere for ^{48}Ti, ^{58}Fe, ^{58}Ni, and ^{90}Zr; and the ^{58}Ni large-angle cross sections were measured at 36.8, 37.4, 37.5, and 38.1 MeV in order to justify the use of the optical-model potential to describe large-angle scattering. Cross sections were also measured at 37.7 MeV for the ^{48}Ti(^{3}He,d)^{49}V and ^{50}Ti(^{3}He,d)^{51}V reactions. The strength of the isospin potential is consistent with strengths derived from DWBA analyses of the (^{3}He,t) reaction. The isospin-dependent term was not inconsistent with the nine sets of 37.7-MeV ^{3}He elastic scattering data. The well-known ambiguities in the mass-3 optical-model potentials were examined for two families of potentials. No definitive preference for one family of potentials was observed. Multiset fits produced average sets of potentials that consistently gave somewhat better fits when the deeper real well was used; however, fits to individual data sets exhibited a slight preference for the shallower real depth. A spin–orbit potential was used in some of the elastic-scattering analyses. The inclusion of a fixed spin–orbit potential of 2 MeV strength improved the description of the 37.7-MeV ^{3}He data. The strength of this spin–orbit term was consistent with theoretical calculations and upper limits set by double-scattering experiments. DWBA analysis of the ^{48}Ti(^{3}He,d)^{49}V and ^{50}Ti(^{3}He,d)^{51}V ground-state reactions was performed to test the effect of the ^{3}He optical-model ambiguities. It was found that satisfactory descriptions of the data were obtained only when the deeper ^{3}He real well depth was used. (TSS) (Diss. Abstr. Int., B)

25684 TWO-LEVEL ANALOG RESONANCE. Devyatko, Yu. N. Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: 883-7(Apr 1970). (In Russian).

In the situation in which the analog splits into two, the magnitude of proton width of the analog state found experimentally was compared to the width of analog states calculated on the basis of theoretical analog states experimentally the described situation may exist during the analog excitation of the ^{49}Ca ground state. (R.V.J.)

25685 INTERACTION OF FAST NEUTRONS WITH Fe, Cu, AND Nb NUCLEI. Salnikov, O. A.; Lovchikova, G. N.; Kotelnikova, G. V.; (and others). Yadern. Fiz.; 12: 1132-42(Dec 1970) (In Russian).

Spectra and differential cross sections of (n,n′) and (n,2n) reactions with Fe, Cu, and Nb nuclei were investigated at the incident neutron energy of 14.4 MeV. The differential cross sections were measured from 30 to 150°. The measurements were done by means of the time-of-light method. Corrections due to the multiple scattering in the sample were introduced using the Monte Carlo method. The nuclear temperatures and the spectra of the final neutrons from the (n,2n) reactions are determined; density parameters for the nuclear levels are calculated on basis of the Fermi-gas nuclear model with account of the residual interaction as pairing energy; the contribution from the direct processes in the inelastic neutron scattering is estimated. (auth)

25686 ANGULAR DISTRIBUTIONS OF PROTONS EMITTED FROM ^{12}C, ^{27}Al, ^{59}Ni, AND ^{181}Ta NUCLEI UNDER EFFECTS OF BREMSSTRAHLUNG WITH THE MAXIMAL ENERGY 1140 MeV. Antuf'ev, Yu. P.; Agranovich, V. L.; Ganenko, V. B.; (and others) (Inst. of Physics and Tech., Kiev). Yadern. Fiz.; 12: 1143-8(Dec 1970). (In Russian).

Angular distributions of photoprotons from ^{12}C, ^{27}Al, ^{59}Ni, and ^{181}Ta nuclei with the energies 80, 160, and 285 MeV were measured 30 to 140°. The total cross sections of proton photoproduction were determined from these data. The experimental results are compared with the calculation made assuming the photo-meson and quasi-deuteron mechanism of proton production. (auth)

25687 NATURE OF EXCITED STATES OF ^{75}As NUCLEUS. Azimov, K. Sh.; Begzhanov, R. B.; Salikhbaev, K. T.; Teshabaev, K. T. (Tashkent State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 114-17(1970). (In Russian).

The nature of ^{75}As excited states was determined by measuring the g factors and lifetimes of the levels and by angular correlations of γ radiation in solid and liquid sources. The data obtained were correlated with various theories. (tr-auth)

25688 CALCULATED ISOMERIC CROSS SECTION RATIOS IN THE REACTION ^{80}Se(n,γ)^{81m,g}Se. Koroleva, V. P. This paper was summarized in At. Energ. (USSR); 28: 497-8(Jun 1970) as paper No. 400/5512. (In Russian).

The isomeric-cross-section ratio is calculated for the reaction ^{80}Se(n,γ)^{81m,g}Se for neutrons with energies from thermal to 3 MeV. The calculation uses the formula for the nuclear level density ρ based on the Fermi gas model and takes account of the dependence of ρ on the excitation energy and the angular momentum. The theoretical curve is compared with the experimental points. For an excitation energy of about 7 MeV an effective nuclear moment of inertia for the ^{80}Se nucleus equal to about 0.85 of the rigid-body value is found. (R.W.R.)

25689 NUCLEAR SPIN AND MAGNETIC MOMENT OF THE GROUND STATE OF ^{49}Cr. Joensson, J. O.; Sanner, L.; Wannberg, B. (Uppsala Univ.). Phys. Scr.; 2: 16-18(1970).

The atomic-beam magnetic-resonance method has been used for measurements of the spin and hyperfine structure of the ground state of ^{49}Cr (42 m) with the following results: I = 5/2, |a| = 49.754 (2) MHz and |b| = 0.018 (17) MHz. The magnetic dipole moment has been calculated from the measured hfs and the known values for ^{53}Cr to be $|\mu_I|$ = 0.476 (3) n.m. (auth) (Sweden)

25690 LOW LYING ENERGY LEVELS IN ^{70}Ga AND ^{72}Ga EXCITED IN THERMAL NEUTRON CAPTURE REACTIONS. Linusson, H.; Hardell, R.; Arnell, S. E. (Chalmers Univ. of Tech., Goteborg). Ark. Fys.; 40: 197-214(1970).

The level structures of the odd–odd nuclei ^{70}Ga and ^{72}Ga were studied by use of the thermal-neutron capture reactions ^{69}Ga(n,γ)^{70}Ga. High-energy primary gamma rays from isotopically separated targets were obtained with a Ge(Li) pair spectrometer and used to infer the excitation energies of 18 states up to 1.7 MeV in ^{70}Ga and 45 states up to 1.3 MeV in ^{72}Ga. The neutron binding energies were determined to be 7655 ± 1 keV in ^{70}Ga and to 6521 ± 1 keV in ^{72}Ga. Level and decay schemes are proposed for both isotopes, as well as absolute intensity values for all gamma rays observed in the energy range from 100 keV up to the neutron binding energy. (auth) (Sweden)

25691 M1, ΔT = 1 AND ΔT = 0 TRANSITIONS FROM THE $(f_{\frac{5}{2}}d_{\frac{3}{2}}^{-1})$T = 1 AND $(p_{\frac{1}{2}}d_{\frac{3}{2}}^{-1})0^-$, T = 0 STATES IN ^{40}Ca. Tellez, A.; Delaunay, J.; Ronsin, H. (Centre d'Etudes Nucleaires de Saclay, France). Phys. Lett.; 34B: 131-2(1 Feb 1971).

Limits for the lifetimes of the $(f_{\frac{5}{2}}d_{\frac{3}{2}}^{-1})5^-$, 3^-, 2^- T = 1 levels in ^{40}Ca were determined by the Doppler-shift-attenuation method. The excitation energy, γ-ray decay, and lifetime of the $(p_{\frac{1}{2}}d_{\frac{3}{2}}^{-1})0^-$ T = 0 state in ^{40}Ca were also obtained. Particle–hole calculations are performed and compared with experiment. (auth)

25692 BETA-NEUTRINO CORRELATIONS AND LONGITUDINAL NUCLEAR ALIGNMENT IN THE DECAY OF ^{20}Na. Macfarlane, R. D.; Oakey, N. S. (Univ. of Copenhagen. Texas A and M Univ., College Station); Nickles, R. J. Phys. Lett.; 34B: 133-4(1 Feb 1971).

An analysis of the line shapes of α-particle groups from the β-delayed α-particle decay of ^{20}Na revealed a simple method of obtaining $\beta^+-\nu$ anisotropy coefficients and F/GT ratios. Evidence was obtained for existence of a longitudinal nuclear alignment of β recoils from G–T transitions. (auth)

25693 LEVELS OF ^{52}Fe FROM THE ^{54}Fe(p,t)^{52}Fe REACTION. Viano, J. B.; Dupont, Y.; Menet, J. (Institut des Sciences Nucleaires, Grenoble, France). Phys. Lett.; 34B: 397-9(15 Mar 1971).

Twenty-six levels in the self-conjugate nucleus ^{52}Fe were observed in the reaction ^{54}Fe(p,t)^{52}Fe. One T = 1 state and two T = 2 states are seen. Angular distributions have been obtained for seventeen triton groups, corresponding to levels up to 10 MeV excitation. Spin assignments are made from DWBA calculations. (auth)

25694 PROTON PICK-UP FROM THE MAGNESIUM ISOTOPES: ^{24,25,26}Mg(d,τ)^{23,24,25}Na. Kraemer, E.; Mairle, G.; Kaschl, G. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Nucl. Phys.; A165: 353-83(1971).

Energy spectra and angular distributions of the ^{3}He particles from the (d,^{3}He) reaction on ^{24,25,26}Mg have been measured at E_d = 52 MeV with an energy resolution of about 80 keV. Excited states up to 11 MeV have been observed in ^{23}Na. High-lying l = 1 transitions were excited by pick-up from the $1p_{\frac{1}{2}}$ shell. Discrepancies

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of 1p proton separation energies determined by quasi-free scattering and proton pick-up are discussed. The l-values have been determined for transitions to a variety of states with unknown spins in the doubly odd ^{24}Na nucleus. A spin 5^+ can be attributed to the 1.51 MeV level which is then the second member of the 4^+ ground state rotational band. Several previously unknown spins could be determined in the ^{25}Na level scheme. There is an apparent similarity in the proton-hole spectra of ^{23}Na and ^{25}Na and consequently a similar rotational structure. The spectra of ^{23}Na, ^{24}Na, and ^{25}Na are discussed in the framework of the Nilsson model. The spectroscopic factors are compared with shell-model calculations and predictions from a simple rotational model. States which are excited by pick-up from Nilsson orbit no. 7 contain approximately 75% of the total sd strength. This contradicts the rotational model and requires strong band mixing. On the other hand the shell-model calculations account for excitation energies and spectroscopic factors of low-lying positive parity states. The data provide information about T = 1 and T = $^3/_2$ states in mass-24 and mass-25 nuclei, respectively. (auth)

25695 INTERMEDIATE COUPLING MODEL AND SHELL-MODEL DESCRIPTION OF ^{53}Cr AND ^{55}Fe. Carola, T. P. G. (Univ. of Alberta, Edmonton); Ohnuma, H. Nucl. Phys.; A165: 259-76(1971).

The properties of the negative-parity states of ^{53}Cr and ^{55}Fe are investigated in the framework of the intermediate coupling in the unified model and the shell model. Energy levels, electromagnetic transition rates, branching ratios, mixing ratios, lifetimes, and spectroscopic factors have been calculated. It is shown that the two approaches yield comparable results and are in fair agreement with experimental data up to 2.5-MeV excitation. (auth)

25696 SPIN ASSIGNMENTS TO EXCITED STATES OF ^{56}Fe USING INELASTIC PROTON SCATTERING. Mani, G. S. (Manchester Univ., Eng.). Nucl. Phys.; A165: 225-39(1971).

Inelastic proton scattering from ^{56}Fe at 49.35 MeV has been studied with protons from a linear accelerator. Angular distributions for thirty excited states up to an excitation of 7.5 MeV in ^{56}Fe were obtained. Spin and parity assignments to most of the states were made using DWBA analysis with first order collective form factors. The structure of this nucleus is discussed in the light of the present data. (auth)

25697 COMPARISON OF THE REACTIONS (p,2p) AND (d,^{3}He) ON 2s-1d SHELL NUCLEI. Arditi, M.; Bimbot, L.; Doubre, H.; (and others) (Institut de Physique Nucleaire, Orsay, France). Nucl. Phys.; A165: 129-44(1971). (In French).

Results of (d,^{3}He) reactions on ^{23}Na, ^{24}Mg, ^{27}Al, and ^{28}Si at E_d = 80 MeV are given. A comparison is made between (p,2p) and (d,^{3}He) reactions on the same nuclei. Quantitative results are in good agreement. The "anomalous" angular distributions observed in (p,2p) reactions can be interpreted as a superposition of l = 0 and l = 1 distributions, the last being shifted by stronger distortion. The 1p proton hole state observed on 2s-1d shell nuclei by pick-up reactions or quasielastic diffusion have been collected. The 1p shell is spread over about 15 MeV in ^{24}Mg, ^{28}Si, and ^{32}S; this leads to some difficulties in the determination of its center of gravity and in the comparison with the theoretical predictions. (auth)

25698 TRUNCATED SHELL MODEL CALCULATION OF ^{23}Na, ^{24}Mg, AND ^{28}Si. McGrory, J. B. (Oak Ridge National Lab., Tenn.); Wildenthal, B. H. Phys. Lett.; 34B: 373-6(15 Mar 1971).

Results of an s-d-shell model calculation of ^{23}Na, ^{24}Mg, and ^{28}Si are discussed. An inert ^{16}O core is assumed and states with up to four $d_{\frac{5}{2}}$ holes and at most two $d_{\frac{3}{2}}$ particles are included. The calculated level energies of ^{23}Na and ^{24}Mg are in excellent agreement with the observed spectra. Fair agreement for ^{28}Si is also obtained if the $d_{\frac{5}{2}}-s_{\frac{1}{2}}$ interaction is strengthened by 400 keV over that used for A = 23 and 24. (auth)

25699 QUADRUPOLE MOMENT OF THE FIRST EXCITED STATE IN ^{36}Ar. Nakai, K.; Stephens, F. S.; Diamon, R. M. (Univ. of California, Berkeley). Phys. Lett.; 34B: 389-91(15 Mar 1971).

The static quadrupole moment of the first excited state in ^{36}Ar was measured by the reorientation effect in projectile Coulomb excitation. The results are $Q(^{36}Ar, 2^+) = +0.11 \pm 0.06$ b and $B(E2; 0^+ \rightarrow 2^+) = 0.032 \pm 0.005$ e^2b^2. (auth)

25700 ELASTIC SCATTERING OF 50 MeV PROTONS BY NUCLEI IN THE RANGE FROM ^{42}Ca TO ^{208}Pb. Mani, G. S.; Jones, D. T.; Jacques, D. (Univ. of Manchester, Eng.). Nucl. Phys.; A165: 384-92(1971).

Differential cross sections for elastic scattering of 50-MeV protons by nineteen nuclei spread over the range from ^{42}Ca to ^{208}Pb were measured. Polarization measurements for some of these nuclei were also done. The data were analyzed in terms of standard optical model. The extraction of the symmetry term from the variation of the real part of the potential with mass number A and isospin T is discussed. (auth)

25701 MEASUREMENT OF THE LIFETIME OF THE ISOMERIC LEVEL ^{78m}Br. Demuynck, J.; Dorikens-Vanpraet, L.; Dorikens, M.; Uyttenhove, J. (Ghent Univ.). J. Phys. (Paris); 31: 915-17(Nov-Dec 1970). (In French).

The isomeric state ^{78m}Br was produced by (γ,n) reaction with natural bromine. The experimental technique, which consists of observing the decay in isomeric transitions between accelerator beam pulses, is discussed. A half-life ($T^1/_2$) of (119.2 ± 1.0) μs was measured for the (148.4 ± 0.2)-keV de-excitation transiton of ^{78m}Br. (France)

25702 STUDY OF THE (^{3}He,α) REACTION WITH ^{28}Si AND ^{32}S. Rotbard, G.; Ronsin, G.; Kalifa, J.; Vergnes, M. (Paris Univ., Orsay, France). J. Phys. (Paris); 31: 933-9(Nov-Dec 1970). (In French).

The angular distributions and excitation functions of (^{3}He,α) reactions leading to several ^{27}Si and ^{31}S levels were measured. The $^1/_2$+ levels of ^{27}Si and ^{31}S, both forbidden in pick-up reactions, are nevertheless quite heavily populated and present large cross sections. Fluctuations are observed in the cross sections of reactions leading to the ground state whose associated wave functions contain a large number of single hole states. The mean angular distributions allow spectroscopic factors to be determined. (France)

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Refer also to abstracts 23825, 23837, 25460, 25629, 25641, 25665, 25668, 25674, 25683, 25685, 25686, and 25700.

25703 (AAEC/E-211) INTERPOLATIVE FORMULAE FOR AVERAGE NUCLEAR LEVEL SPACING AND TOTAL RADIATION WIDTH. Musgrove, A. R. de L. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov 1970. 46p. Dep. NTIS (U. S. Sales Only).

The free-gas-model formula for nuclear level densities was used to interpolate unknown level spacings. The level-density parameter was fitted semi-empirically to give good fits to all experimentally measured level spacings. A formula for total radiation width is given which relates this quantity to the mass number, the average level spacing and the excitation energy. Compound nuclei which have a long-lived isomeric state were found to have, on average, a radiation width 25 percent less than for non-isomeric compound nuclei. No correlation between radiation widths and neutron strength function was observed within the limits of accuracy of the experimental data, contrary to some previous suggestions. Tables of calculated and measured resonance parameters are given for target nuclei in the range 60 < A < 203. The calculated 30-keV capture cross section is compared with measured and semi-empirical data and with calculated values. (auth) (Australia)

25704 (ANL-7611) ANALYSIS OF COMPTON CONTINUUM MEASUREMENTS. Gold, R.; Olson, I. K. (Argonne National Lab., Ill.). Feb 1970. Contract W-31-109-eng-38. 84p. Dep. NTIS.

Five computer programs, COMPSCAT, FEND, GABCO, DOSE, and COMPLOT, were developed and used for the analysis and subsequent reduction of measured energy distributions of Compton recoil electrons to continuous gamma spectra. In addition to detailed descriptions of these computer programs, the relations among these codes are stressed. The manner in which these programs function is illustrated by tracing a sample measurement through a complete cycle of the data-reduction process. (auth)

25705 (ANL-7739) PHYSICS DIVISION SUMMARY REPORT, APRIL-SEPTEMBER 1970. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 86p. Dep.

Research progress at the Physics Division of Argonne National Laboratory in the period April through September 1970, is summarized. (J.W.R.)

25706 (BARC-474) PROGRESS REPORT ON NUCLEAR DATA ACTIVITIES IN INDIA. VI. Balakrishnan, M. (comp.) (Bhabha Atomic Research Centre, Bombay (India)). 1970. 63p. Dep. NTIS (U. S. Sales Only).

Progress in nuclear data activities in India during 1969 is reported. (J.W.R.)

25707 (BMBW-FBK-70-30) STRUCTURE INVESTIGATIONS OF NEUTRON-DEFICIENT HOLMIUM AND DYSPROSIUM NUCLEI. Schepers, H. (Bonn Univ. (West Germany). Institut fuer Strahlen und Kernphysik). Dec 1970. 61p. (In German). Dep. NTIS (U. S. Sales Only).

By irradiation of terbium with alpha particles the radioactive isotopes ^{156}Ho, ^{158}Ho, and ^{160}Ho were produced. Singles and x–y coincidence spectra were measured by using Ge(Li) detectors and computer methods to study the energy levels of these nuclei. The existence of several new Ho isomers is proposed. For the Dy nuclei a large number of gamma energies and nuclear levels were found. It was possible to identify some two-quasi-particle states by measuring the allowed, unhindered transitions from the odd–odd nuclei ^{156}Ho, ^{158}Ho, and ^{160}Ho to the corresponding even–even nuclei ^{156}Dy, ^{158}Dy, and ^{160}Dy, especially the transition p $7/2^-$(523) n $11/2^-$(505) ($I\pi = 9^+$) to the state n $5/2^-$(523) n $11/2^-$(505) ($I\pi = 8^+$) for all isotope pairs mentioned. The importance of the occupation probability of the neutron state $11/2^-$(505) for the sudden change of nuclear shape in the transition region near N = 89 is discussed. (auth)

25708 (CERN-71-2) STUDY OF NUCLEAR FISSION INDUCED BY HIGH-ENERGY PROTONS. CERN-Heidelberg-Naples-Warsaw Collaboration. Brandt, R.; Carbonara, F.; Cieslak, E.; Piekarz, H.; Piekarz, J.; Zakrzewski, J. (European Organization for Nuclear Research, Geneva (Switzerland)). 19 Jan 1971. 26p. Dep. NTIS (U. S. Sales Only).

Cross sections for binary fission of bismuth, gold, lead, uranium, and some lighter elements were determined using the mica-sandwich technique for proton energies between 0.59 and 23 GeV. (43 references) (auth)

25709 (CONF-710301-6) AUTOMATED CROSS SECTION ANALYSIS PROGRAM (ACSAP). Marshall, N. H.; Codding, J. W.; Simpson, O. D.; Smith, J. R. (Idaho Nuclear Corp., Idaho Falls). [1971]. 7p. Dep. NTIS.

From 3. conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

The Automated Cross Section Analysis Program (ACSAP) is a FORTRAN computer program developed to speed the analysis of neutron cross section data. The program automatically adjusts single-level or multilevel resonance parameters until the theoretical curve is in good agreement with a preselected set of experimental data points. The procedure is essentially an iterative method with ACSAP adjusting the resonance parameters for each iteration. Total, fission, capture, or scattering data may be fitted. Data from the final iteration (or even intermediate ones) may be printed or plotted at the user's discretion. ACSAP allows each user to "program" his problem, making the code very flexible and easy to use. This versatility makes ACSAP a powerful tool in cross-section evaluations. (auth)

25710 (JINR-E4-5607) ON ISOMERIC $8^- \rightarrow 6^+$ TRANSITION IN THE ^{130}Ba NUCLEUS. Arsen'ev, D. A.; Dzholos, R. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1971. 15p. Dep. NTIS (U. S. Sales Only).

A model describing some properties of the transition nuclei is given. In verifying the validity of this model the results of the calculations of the ground- and excited-state energies of these nuclei are employed. The origin of the isomeric 8^- state in the ^{130}Ba nucleus is clarified. (auth)

25711 (JINR-P3-5609) ^{238}U NEUTRON RESONANCE RADIATION WIDTHS. Maletski, Kh.; Pikel'ner, L. B.; Salamatin, I. M.; Sharapov, E. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1971. 10p. (In Russian). Dep. NTIS (U. S. Sales Only).

The radiative capture and transmission of neutrons were measured on the pulsed fast reactor IBR with the injector (linear accelerator) for ^{238}U with the resolution time being 6 ns/m. Radiation with values Γ_γ for 30 resonances and neutron widths Γ_n for 38 resonances were obtained. The average width g Γ_γ = 24 MeV and the divergences of separate radiation widths from the average one do not exceed the measurement error. (auth)

25712 (JINR-P4-5576) PAIR VIBRATIONS IN THE YTTERBIUM ISOTOPES. Abdulvagabova, S. K.; Pyatov, N. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1971. 17p. (In Russian). Dep. NTIS (U. S. Sales Only).

The properties of the neutron pair vibrations due to the pair interactions in the ytterbium isotopes are studied. The energies of 0^+-excitations, the presented probabilities of E0- and E2-transitions and the ratio X (the Rasmussen parameter) are calculated as well as the relative probability of the pair vibration excitation in the transfer reactions of two nucleons. (auth)

25713 (JINR-P6-5517) INVESTIGATION OF THE ^{141}Pm LEVELS BY THE DELAYED COINCIDENCES AND THE ANGULAR γ–γ CORRELATION METHOD. Arl't, R.; Baier, G.; Vavryshchuk, Ya.; Morozov, V. A.; Muminov, T. M.; Razov, V. I.; Sazhinski, Ya.; Fuya, Kh.; Shtrusnyi, Kh.; Kherrman, E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1970. 12p. (In Russian). Dep. NTIS (U. S. Sales Only).

The half-lives were measured and the spins for the 196.5 and 628.7 keV levels in the ^{141}Pm nucleus were determined. (auth)

25714 (JINR-P6-5518) INVESTIGATION OF THE ^{155}Gd LEVELS BY THE METHOD OF DELAYED COINCIDENCES AND ANGULAR γ–γ CORRELATIONS. Vavryshchuk, Ya.; Vinogradova, N. V.; Morozov, V. A.; Razov, V. I.; Sazhinski, Ya.; Fuya, Kh.; Zhuk, V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1970. 12p. (In Russian). Dep. NTIS (U. S. Sales Only).

The half-lives were measured and the spins of some ^{155}Gd levels were determined by the method of delayed coincidences and angular γ–γ correlations. (auth)

25715 (JINR-P6-5594) NEW ISOTOPE ^{92}Ru. Arl't, R.; Bayar, B.; Zaitseva, N. G.; Kratsik, B.; Novgorodov, A. F.; Severa, F.; Tran-Thanh-Minh (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1971. 6p. (In Russian). Dep. NTIS (U. S. Sales Only).

Several experiments were carried out in search for the ^{92}Ru isotope. The Ag samples were irradiated by 660 MeV protons for 3 to 5 minutes and transferred along the pneumatic (rabbit) system into the preheated oven for Ru element fraction extraction (2.5 to 3 min), gamma spectra were then measured for a number of equal time intervals using a 38-cm^3 Ge(Li) detector with a resolution of about 3.6 keV at the 662-keV ^{137}Cs line and recorded for the further evaluation. The decay of selected lines in ^{92}Tc was investigated (especially those at 148 keV and 1509 keV). They were compared with those in the Tc fraction, which was measured for comparison under the same conditions along with the Ru fraction. The long-lived isotope measurements carried out for several days after the irradiation ensured that there was no observable admixture of Tc in the Ru fraction. According to the growth and decay of the daughter ^{92}Tc lines, the half-life of ^{92}Ru was determined to be (2.5 ± 1) min. (auth)

25716 (LUNP-7103) HIGH ENERGY (γ,xn) REACTIONS IN ^{197}Au. Lindgren, K.; Jonsson, G. G. (Lund Inst. of Tech. (Sweden). Dept. of Nuclear Physics. Lund Univ. (Sweden). Dept. of Physics). Jan 1971. 43p. Dep. NTIS (U. S. Sales Only).

The bremsstrahlung-induced yields of some (γ,xn) reactions, $1 \leq x \leq 15$, in gold have been measured in the energy region 75-900 MeV. The mean cross sections in the energy region 300-900 MeV were determined. The number of valence neutrons available in the (γ,n) reaction was estimated. The experimental cross sections of the more complex reactions are compared with cascade–evaporation calculations based upon the free-nucleon photo-pion cross sections. Fission competition must be taken into account to explain the experimental cross sections. From comparison between experimental and calculated cross sections it is found that fission is most probable at low excitation energy after the emission of several neutrons. Fission fragments were observed in a catcher foil experiment and the relative yields were determined. For two reactions the isomeric yield ratios were determined. (auth) (Sweden)

25717 (LYCEN-7002) ANNUAL REPORT [ON NUCLEAR PHYSICS FOR 1969]. (Lyon Univ. (France). Institut de Physique Nucleaire). Jan 1970. 134p. (In French). Dep. NTIS (U. S. Sales Only).

Research at the Nuclear Physics Institute at the University of Lyon in 1969 is summarized. The work included spectroscopic studies of nuclear structure, radiochemical studies of nuclear reactions, development of nuclear instrumentation, and theoretical studies in high-energy nuclear physics. (J.W.R.)

25718 (MNC-3783-9) RESEARCH IN NUCLEAR CHEMISTRY. Progress Report, 1970. Viola, V. E. Jr. (Maryland Univ., College Park. Dept. of Chemistry). Nov 1970. Contract AT(40-1)-3783. 25p. Dep. NTIS.

AIR—monitoring for alpha radioactivity at Frederick, Maryland in November, 1970
ELEMENT-110—alpha decay of, half-life calculations for even A = 280 to 292 isotopes, (T)
ELEMENT-112—alpha decay of, half-life calculations for even A = 284 to 296 isotopes, (T)
ELEMENT-114—alpha decay of, half-life calculations for even A = 288 to 298 isotopes, (E)
HOLMIUM-165—nitrogen-14 reactions with, fission to neutron evaporation ratio in, (E/T)

LUTETIUM-175—boron-11 reactions with, fission to neutron evaporation ratio in, (E/T)
—carbon-12 reactions with, fission to neutron evaporation ratio in, (E/T)
RADON-220—content in air at Frederick, Maryland in November, 1970
TERBIUM-159—fluorine-19 reactions with, fission to neutron evaporation ratio in, (E/T)
THULIUM-169—boron-11 reactions with, fission to neutron evaporation ratio in, (E/T)
—carbon-12 reactions with, fission to neutron evaporation ratio in, (E/T)
TUNGSTEN-182—carbon-12 reactions with, fission to neutron evaporation ratio in, (E/T)
URANIUM-238—alpha fission at 63.5 MeV, fragment energy spectra and angular correlations from, (E)
YTTERBIUM-174—carbon-12 reactions with, fission to neutron evaporation ratio in, (E/T) (J.W.R.)

25719 (NP-18644) THEORETICAL CORRELATION COEFFICIENTS AS FUNCTIONS OF THE MIXING RATIO δ FOR TRIPLE γ-RAY CASCADES WITH INTERMEDIATE TRANSITION UNOBSERVED. Research Report No. 10/1970. Helppi, H.; Hattula, J. (Jyvaskyla Univ. (Finland). Dept. of Physics). Oct 1970. 8p. Dep. NTIS (U. S. Sales Only).

In directional-correlation measurements one can obtain correlation functions for many cascades simultaneously. There are often several correlations with one or more unobserved intermediate gamma rays in the cascades. Tables were compiled to facilitate the interpretation of the triple correlations with intermediate transition unobserved and the determination of the mixing ratio parameter δ. The method used in calculating the tables is described. The tables themselves are not included, but may be purchased from the university library. (R.W.R.)

25720 (NP-18694) BETA-GAMMA CIRCULAR POLARIZATION CORRELATION MEASUREMENTS ON SOME ODD-MASS NUCLEI. van Rooijen, Jan Johan (Vrije Universiteit, Amsterdam (Netherlands)). 1970. 103p. Dep. NTIS (U. S. Sales Only).

Thesis.

Beta–gamma circular-polarization correlation measurements on transitions in several odd-mass nuclei are reported. Some theoretical aspects of first-order-forbidden decay are outlined. Detection of circular polarization of γ rays is generally accomplished by using the spin dependence of Compton scattering. The framework for the description of interactions of polarized beams of photons is reviewed, and various types of polarimeters are discussed. $\beta-\gamma$ circular-polarization correlation measurements were performed on the 210-keV $\beta-279$-keV γ cascade in ^{203}Hg; the results seem to be incompatible with the Coulomb approximation. Failure to obtain satisfactory fits to the data indicates that the data and the theoretical framework are not compatible. Some measurements were made of the $\beta-\gamma$ circular-polarization correlation of the $\frac{3}{2} \rightarrow \frac{3}{2} \rightarrow \frac{1}{2}$ cascade in the decay of ^{199}Au; the results were inconclusive. The $\beta-\gamma$ circular-polarization correlation in the decay of ^{141}Ce was also measured, and the energy dependence of the circular-polarization correlation was traced. Some approximate relations between the matrix elements were found. (R.W.R.)

25721 (NP-18704) MAGNETIC MOMENTS AND MIXING RATIOS IN THE γ-DECAY OF ^{125}Te. Rots, M.; Silverans, R.; Coussement, R. (Louvain Univ. (Belgium). Instituut voor Kern-en Stralingsfysika). [1970]. 22p. Dep. NTIS (U. S. Sales Only).

Angular correlations in the γ decay of ^{125}Te were investigated with a Ge(Li) and NaI(Tl) detector combination. The results for the character of the observed transitions are as follows: two pure M1 transitions (172 and 209 keV); two pure E1 transitions (117 and 320 keV); one pure E2 transition (379 keV); and, finally, one mixed transition (204 keV, $-1.36 < \delta(E2/M1) < -0.47$). Moreover, two magnetic moments, $\mu\bar{\zeta} = -(0.66 \pm 0.09)$ nm (321-keV state) and $\mu\zeta = +(0.79 \pm 0.30)$ nm (463-keV state) are determined, together with the precession angle $\omega\tau = +0.107 \pm 0.024$ rad for the 525-keV state. All these data, complemented by the results of Coulomb-excitation and (d,p)-reaction work, are useful in explaining the level structure in the ^{125}Te decay scheme. The experimental results are compared with the predictions of the Kisslinger–Sorensen calculations, and a striking agreement is found. Some comments are also made about the experimental conditions of the earlier measurements of the anticipated three-quasi-particle state at an excitation energy of 321 keV. (auth)

25722 (ORNL-4592) NEUTRON PHYSICS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING MAY 31, 1970. (Oak Ridge National Lab., Tenn.). Sep 1970. Contract W-7405-eng-26. 116p. Dep. CFSTI.

ATMOSPHERE—neutron spectra in upper, in 2 to 60 MeV range
—gamma spectra in upper
CARBON-12—neutron elastic scattering at 2 to 4.4 MeV, R-matrix analysis of, (T)
GAMMA RADIATION—spectra in upper atmosphere
NEUTRONS—reactions with fissile nuclei, multilevel effects in cross sections for, (T)
NEUTRONS, FAST—spectra in upper atmosphere, in 2 to 60 MeV range
NUCLEI—neutron reactions with fissile, multilevel effects in cross sections for, (T)
URANIUM-233—neutron fission at 0.02 to 1 eV, cross section for, (E)
URANIUM-238—neutron capture up to 100 keV, cross section for, (E) (J.W.R.)

25723 (RFP-1469) HALF-LIFE OF ^{239}Pu BY CALORIMETRY. Oetting, Franklin L. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). [nd]. Contract AT(29-1)-1106. 10p. Dep. NTIS.

The power output from two 1-kilogram samples of pure plutonium metal was determined by isothermal calorimetry. The major isotopic constituent in both samples was plutonium-239, accounting for 93% in the first sample and 97% in the second sample. After making power corrections for the remaining isotopes, the specific power output of plutonium-239 was found to be $1.931 \pm 0.004 \times 10^{-3}$ watts/ gram. The power emitted by the two samples remained essentially constant (±0.1%) for a period of four months. Using the alpha zero energy for plutonium-239 of 5.1556 MeV and the recoil energy of 0.863 MeV, the alpha half-life of plutonium-239 was calculated to be 24,065 ± 50 years. This is compared to the currently accepted value of 24,400 ± 30 years as determined by absolute alpha (specific activity) low-geometry counting techniques. (auth)

25724 (RLO-1388-121) ANNUAL REPORT, 1970. (Washington Univ., Seattle. Nuclear Physics Lab.). Jun 1970. Contract AT(45-1)-1388. 173p. Dep. CFSTI.

AMPLIFIERS—development of direct coupled low noise time pickoff, for silicon detector,
CARBON-12—proton elastic and inelastic scattering at 20 MeV, angular distribution for, (E)
—alpha reactions (α,d) at 42 MeV, deuteron spectra and angular distributions for, (E)
—alpha reactions (α,pn) at 42 MeV, analysis of final-state interaction in, (E)
—alpha reactions (α, Li-6) and (α, Be-7) at 42 MeV, differential cross sections for, (E)
CERIUM-140—oxygen-16 reactions at 60 MeV, energy spectra of products from, (E)
COMPUTERS—development at Univ. of Washington, April, 1970
COPPER-65—alpha reactions at 40 MeV, γ spectra from, (E)
CYCLOTRONS—development and operation of Univ. of Washington, April, 1970
DATA PROCESSING SYSTEMS—development of computer-based, at Univ. of Washington, April, 1970
DEUTERIUM—proton reactions (p, 2p) at 7 to 14.5 MeV, analysis for helium-3 resonances in excitation function for, (E)
GADOLINIUM-154—energy levels and transitions from samarium-154 (α, 4n) reactions, (E)
GAMMA SPECTROMETERS—development of Compton suppression lithium-drifted germanium,
HELIUM-3—alpha reactions (α,n) at 42 MeV, neutron spectra from, (E)
—alpha reactions (α, p) at 42 MeV, proton spectra from, (E)
ION SOURCES—development for Univ. of Washington Van de Graaff accelerator,
IRON-54—proton elastic and inelastic scattering near 20 MeV, excitation functions for, (E)
LEAD-208—oxygen-16 reactions at 70 MeV, energy spectra of of products from, (E)
LITHIUM-6—deuteron reactions (d, pn) at 21 MeV, analysis for reaction mechanism in, (E)
—deuteron elastic and inelastic scattering at 21 MeV, angular distributions for, (E)
—helium-3 elastic and inelastic scattering at 25.5 MeV, angular distributions for, (E)
MOLYBDENUM-92—proton elastic and inelastic scattering near 20 MeV, excitation functions for, (E)
NICKEL-58—proton elastic and inelastic scattering at 20 MeV, angular distributions for, (E)
—alpha inelastic scattering at 23.3 MeV, $\alpha-\gamma$ angular correlations from, (E)
—alpha elastic and inelastic scattering at 23.3 MeV, cross sections for, (E)

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NICKEL-64—alpha elastic and inelastic scattering at 23.3 MeV, cross sections for, (E)
OXYGEN-16—alpha reactions (α, B-10), (α, Be-7), (α, Li-6), and (α, Li-7) at 42 MeV, differential cross sections for, (E)
OXYGEN-18—oxygen-18 elastic scattering at 15 to 55 MeV, excitation function for, (E)
—targets of, preparation of
PLUTONIUM-237—fission of 108 nsec isomer of, decay curve for spontaneous, (E)
RADIATION DETECTORS, SCINTILLATION—development of sodium iodide, for high energy gamma radiation
—performance of NE 213, for neutrons
SAMARIUM-154—alpha reactions (α, 4nγ) at 42 MeV, γ spectra from, (E)
SILICON-28—alpha reactions (α, C-12) and (α, O-16) at 42 MeV, differential cross sections for, (E)
TRITIUM—deuteron reactions (d, He-3) 2n at 16 MeV, analysis of n-n final state interaction in, (E)
—alpha reactions (α, p) at 42 MeV, proton spectra from, (E)
VAN DE GRAAFF ACCELERATORS—development and operation of Univ. of Washington, April, 1970
—accident at Univ. of Washington, due to vacuum seal failure in injector
—beam focusing monitor for
ZINC-64—alpha reactions at 40 MeV, γ spectra from, (E)
ZINC-63—alpha elastic and inelastic scattering at 23.3 MeV, cross sections for, (E) (W.H.K.)

25725 (RPI-328-220) CROSS-SECTION DATA ANALYSIS UTILIZING AN INTERACTIVE GRAPHICS DISPLAY. Lubert, M. (Knolls Atomic Power Lab., Schenectady, N. Y.); Block, R. C. (Rensselaer Polytechnic Inst., Troy, N. Y.). [1969]. Contract AT(30-1)-328. 8p. Dep. NTIS.

The interactive graphics program permits a rapid analysis of experimental capture and transmission data, eliminating the normal slow batch processing. The program MULTLVL is modular in design. The base overlay is a monitor program which executes a specified calculational path in which the final results are displayed on a CRT. The user can modify the path as well as the physical parameters (theoretical and experimental) for all the modules while in display mode. The final results may be automatically transferred to computer-generated plots, microfilm, and/or printer plots. A typical analysis for one hundred resonances computes the resolution-broadened transmission for two thousand energy points in approximately 5 minutes on a CDC-6600. (auth)

25726 (RPI-328-223) RESONANCE PARAMETERS OF ^{240}Pu FROM 20 TO 500 eV. Hockenbury, R. W.; Boice, J. D.; Moyer, W. R.; Block, R. C. (Rensselaer Polytechnic Inst., Troy, N. Y.). [1970]. Contract AT(30-1)-328. 7p. Dep. NTIS.

Neutron absorption and transmission measurements were made on ^{240}Pu from 20 eV to about 1 keV as part of an experiment to measure the keV capture cross section. A high-low bias technique was used in the absorption measurements to separate the fission and capture components and upper limits can be set on the fission widths of these resonances. The capture data were normalized in two ways: (1) by the saturated capture method and (2) to transmission data where both capture and transmission give essentially the same result, $g\Gamma_n$. The normalizations agree within statistics. The advantages and sources of error of each method are examined. These data have been analyzed for resonance parameters. Our results for the radiation widths are 15 to 25% larger than previously reported values. (auth)

25727 (RPI-328-224) TEMPERATURE-DEPENDENT TRANSMISSION AND SELF-INDICATION MEASUREMENTS UPON Ta IN THE UNRESOLVED REGION. Byoun, T. Y.; Block, R. C. (Rensselaer Polytechnic Inst., Troy, N. Y.); Semler, T. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). [1969]. Contract AT(30-1)-328. 6p. (CONF-710301-10). Dep. NTIS.

From 3. conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Neutron-transmission and self-indication measurements were carried out at the RPI LINAC on Ta up to 100 keV in order to study the effects of resonance self-shielding in the unresolved region. For both types of measurements a Ta sample 0.1-, 0.5-, 1.0-, or 1.5-cm thick was alternated in and out of the neutron beam. A series of measurements was carried out with the alternating sample maintained at 77°K, 295°K, and 1073°K. These measurements are interpreted by stochastically generating chains of "pseudo" resonances from the known distribution laws and fitting the data over the range of energies and sample thicknesses used in the experiment. (auth)

25728 (TID-25643) SHORT-LIVED DELAYED NEUTRON AND PHOTONEUTRON GROUPS FROM FISSION FRAGMENTS OF ^{239}Pu IN LIGHT AND HEAVY WATER. Huizinga, Martin (Virginia Polytechnic Inst., Blacksburg). Nov 1968. Contract AT-(40-1)-2686. 78p. Dep. NTIS.

Thesis.

A search for short-lived (20-0.002 sec) delayed neutron groups and short-lived delayed photoneutron groups was made for ^{239}Pu in D_2O. A ^{239}Pu target was placed in the center of a sphere of D_2O and a chopped neutron beam from the V. P. I. reactor was allowed to impinge on the target. The ^{239}Pu target was then placed in light water and the procedure was repeated. The time of a chopper revolution varied from 319 to 0.034 sec in six steps. The ratio of "chopper open" to "chopper closed" time is 1 to 24. During the "chopper closed" time interval, the production rate of delayed neutrons or delayed neutrons plus photoneutrons as a function of time was stored in a timebase multichannel analyzer. The resulting decay curves were then fitted to a sum of exponentials with a linear least squares computer program. The results are shown below:

$T_{\frac{1}{2}}$ (sec)	A_i
54.5	0.074
21.1	0.257
5.67	0.218
2.12	0.343
0.40	0.108

A_i is the abundance of the ith group and is the fraction of the abundance due to all the groups. Delayed neutron groups with half-lives shorter than 0.43 sec do not exist for ^{239}Pu. A search for photoneutron groups with half-lives between 20 and 0.002 sec provided negative results. These results are in agreement with beta-decay theory. 21 references. (auth)

25729 (TID-25645) DELAYED NEUTRON GROUPS FROM ^{235}U AND ^{233}U AND SHORT-LIVED DELAYED PHOTONEUTRON GROUPS FROM ^{235}U AND ^{233}U IN D_2O. Rambo, George Earle (Virginia Polytechnic Inst., Blacksburg). May 1969. Contract AT(40-1)-2686. 129p. Dep. NTIS.

Thesis.

A study of the delayed neutron groups from ^{235}U and ^{233}U was made using the rotating chopper method developed by Onega et al. The uranium targets were irradiated by a pulsed beam from a reactor and the neutron activity of the targets during the closed portion of the chopper rotation cycle measured as a function of time. The chopper and a multichannel analyzer were coordinated to allow rapid data accumulation by super-imposing data from successive chopper rotations. Several chopper rotation speeds were used to enhance the various half-life delayed neutron groups. The decay curves were fit to a sum of exponentials by a least squares computer program which determined the half-lives and abundances of the groups. The abundances were corrected for non-saturation and build-up. The half-lives, $T_{\frac{1}{2}}$, and relative abundances, β_i/β, of the groups found are given. Unsuccessful efforts were made to resolve the fifth groups found into the two shortest groups reported by Keepin et al. No shorter lived delayed neutron groups were found even though the experiment was capable of resolving half-lives as short as a few milliseconds. A search for short-lived delayed photoneutron groups from ^{235}U and ^{233}U in D_2O was made. The same experimental technique was used except that the uranium targets were mounted at the center of a sphere filled with D_2O. No delayed photoneutron groups with significant abundance were found with half-lives between 0.002 seconds and 10 seconds. 33 references. (auth)

25730 (UCRL-20412) DECAY STUDIES OF NEUTRON-DEFICIENT ISOTOPES OF ASTATINE, POLONIUM, AND BISMUTH. Dairiki, Janis M. (California Univ., Berkeley. Lawrence Radiation Lab.). Nov 1970. Contract W-7405-eng-48. 159p. Dep. NTIS.

Thesis.

Alpha particle and gamma ray studies were made of the decay of neutron-deficient isotopes of astatine, polonium, and bismuth. Astatine isotopes were produced in Au(^{12}C,xn) reactions at the Berkeley Heavy Ion Linear Accelerator (HILAC). Polonium and bismuth sources were obtained as products of astatine decay. Three kinds of experiments were performed: measurements of alpha particle energies and branching ratios, high resolution gamma-ray singles studies, and gamma-gamma coincidence measurements. In the gamma-ray studies measurements were made on a source containing a mixture of isotopes with no previous chemical separation, primarily due to the short half-lives involved. Computer codes were developed to analyze the resulting complex multicomponent gamma spectra. Decay schemes were

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constructed for even-mass At isotopes, A = 202 to 206. Confirming evidence was obtained in alpha measurements for an isomeric state of ^{202}At. Partial decay schemes were deduced for ^{205}At and ^{203}At, characterized by intense direct population of a $^9/_2^-$ excited level in the Po daughters followed by a gamma transition to the $^5/_2^-$ ground states. For $^{203-205}$Po tentative decay schemes were proposed. The odd-mass polonium nuclei exhibit substantial decay to positive parity states in their Bi daughters. In addition, an alpha group at 5.37 ± 0.15 MeV was attributed to ^{203}Po. Finally, a systematic series of energy levels (0^+, 4^+, 4^+, and 5^-) were observed in the even–even Pb nuclei produced in the electron capture decay of $^{198-204}$Bi. (65 references) (auth)

25731 (UCRL–73003) THRESHOLD PHOTONEUTRONS AND PHOTON DOORWAYS. Berman, B. L. (California Univ., Livermore. Lawrence Radiation Lab.). 26 Jan 1971. 45p. (CONF-701210–1). Dep. NTIS.

From American physical society meeting; Stanford, Calif. (28 Dec 1970).

The power of the threshold-photoneutron technique to examine the properties of nuclear states just above the neutron separation energy is elucidated. In particular, the discovery and delineation of doorway states in the photon reaction channel are discussed, specifically for the cases of ^{207}Pb, ^{57}Fe, and ^{208}Pb. (auth)

25732 K X-RAY AND GAMMA-RAY ANGULAR CORRELATIONS IN THE DECAY OF ^{153}Gd AND ^{186}Re USING HIGH-EFFICIENCY SUM-PEAK COINCIDENCE SCINTILLATION SPECTROMETER. Rao, K. Venkata Ramana; Lakshminarayana, V. (Andhra Univ., Waltair, India). Curr. Sci. (India); 40: 101-3(5 Mar 1971).

Sum-peak coincidence spectra were measured for the x and gamma rays following the electron-capture decay of ^{153}Gd and ^{186}Re, and angular correlation coefficients were obtained. In no case does the value of the correlation coefficient exceed the corresponding experimental error. Absence of finite correlation in both cases indicates the essential absence of anisotropy in the gamma-ray distribution. (R.W.R.)

25733 SPECTROSCOPIC FACTORS FOR STRIPPING TO UNBOUND ISOBARIC ANALOG STATES. Youngblood, D. H.; Kozub, R. L. (Texas A and M Univ., College Station). Phys. Rev. Lett.; 26: 572-4(8 Mar 1971).

The reaction ^{92}Mo(^{3}He,d)^{93}Tc leading to unbound isobaric analog states (IAS) was studied. A distorted-wave Born-approximation analysis of the IAS using unbound single-particle form factors is shown to provide good fits and reasonable spectroscopic factors for (^{3}He,d) data from this and other work in the A = 90 region. Calculations for available (d,n) reaction data result in spectroscopic factors which are lower than the (^{3}He,d) values. (auth)

25734 ELECTRON SCATTERING FROM ALIGNED AND NONALIGNED ^{165}Ho NUCLEI. Uhrhane, F. J.; McCarthy, J. S.; Yearian, M. R. (Stanford Univ., Calif.). Phys. Rev. Lett.; 26: 578-82(8 Mar 1971).

The differential scattering cross sections were measured for electron scattering from randomly oriented and aligned ^{165}Ho nuclei. The alignment axis was parallel to the direction of the momentum transferred to the nucleus. Incident electron energies from 160.6 to 462.2 MeV were used at a fixed polar scattering angle of 36°. Available theories are unable to explain the measured difference between the aligned and nonaligned cross sections. (auth)

25735 MEASUREMENT OF LIFETIME OF 47.15- AND 77.25-keV EXCITED STATES IN ^{165}Er NUCLEUS. Babadzhanov, R.; Morosov, V. A.; Muminov, T. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 12: 1097-1104(Dec 1970). (In Russian).

Periods of half-decays of 47.15-keV ($T_{\frac{1}{2}}$ = 4.4 ± 0.7 nsec) and of 77.25-keV ($T_{\frac{1}{2}}$ = 1.1 ± 0.13 nsec) levels of the ^{165}Er nucleus are determined using the delayed e,γ coincidences method. The factors F_M, F_N, $F_N R_\gamma^N$, F_{S-W}, $F_{S-W} R_\gamma^{S-W}$ are calculated for transitions of the type E1 discharging these states. The values $Q_{\theta\,exp}$, β_{exp} and boundary values $\mu_{\theta\,exp}$ of the ground state of ^{165}Er are determined. It is shown that the states $^5/_2{}^5/_2{}^-$[523] ↓ and $^5/_2{}^5/_2{}^+$[642] ↑ (E_{lev} is equal to 0 and 47.15, respectively) are purely one-quasiparticle and the state with the energy 77.25-keV $^7/_2{}^5/_2{}^-$[523] ↓ is the rotation level of the ground state of ^{165}Er. (auth)

25736 ENERGY LEVELS OF ^{234}U ARISING AT DECAY OF ^{238}Pu. Baranov, S. A.; Kulakov, V. M.; Shatinskii, V. M.; Gladkikh, Z. S. Yadern. Fiz.; 12: 1105-7(Dec 1970). (In Russian).

The α spectrum of ^{238}Pu in the energy range from 4500 up to 5500 keV is studied by means of the magnetic α spectograph. Ten α groups are detected, 5 of them correspond to the transitions to the levels of rotation band of the ground state with the quantum numbers from 0^+ up to 8^+. The 788-keV level of ^{234}U is the lowest one in the band due to the octupole nuclear vibrations. The 808-keV and 852-keV levels correspond to the β-vibration states of ^{234}U with the quantum numbers 0^+ and 2^+. (auth)

25737 EVIDENCE FOR THE POSSIBLE EXISTENCE OF A SUPERHEAVY ELEMENT WITH ATOMIC NUMBER 112. Marinov, A. (Rutherford High Energy Lab., Chilton, Eng.); Batty, C. J.; Kilvington, A.; (and others). Nature (London); 229: 464-7 (12 Feb 1971).

Evidence is presented for the possible existence of a superheavy element produced by secondary reactions in a tungsten target bombarded by 24-GeV protons. (auth) (UK)

25738 ALPHA DECAY OF NEUTRON-DEFICIENT OSMIUM ISOTOPES. Borggreen, Joern; Hyde, Earl K. (Univ. of California, Berkeley). Nucl. Phys.; A162: 407-16(1971).

Three neutron-deficient isotopes of osmium were produced by the interaction of ^{16}O ions with erbium targets and observed by their α-decay. They are ^{172}Os, E_α = 5.105 MeV, $t_{\frac{1}{2}}$ = 19 s; ^{173}Os, E_α = 4.94 MeV, $t_{\frac{1}{2}}$ = 16 s; and ^{174}Os, E_α = 4.76 MeV, $t_{\frac{1}{2}}$ = 45 s. The $\alpha/(\beta^+ + e.c.)$ branchings for ^{173}Os and ^{174}Os are both 0.02% and that for ^{172}Os is ≲0.3%. (auth)

25739 LOW ANGULAR MOMENTUM STATES POPULATED IN THE DECAY OF ^{178}Lu. Gujrathi, S. C.; D'Auria, J. M. (Simon Fraser Univ., Burnaby, B. C.). Can. J. Phys.; 49: 270 6(15 Jan 1971).

The low angular momentum states in ^{178}Hf populated in the beta decay of the low spin state ($T_{\frac{1}{2}}$ = 30 min) of ^{178}Lu are investigated with both high resolution and high efficiency Ge(Li) detectors as well as a NaI(Tl)–Ge(Li) (γ,γ) coincidence system. The sources of ^{178}Lu were produced through the ^{178}Hf(n,p) and ^{181}Ta(n,α) reactions on natural targets of hafnium and tantalum, respectively, using 14.8 MeV neutrons. Sixteen gamma transitions in the energy range 1090.8 to 1730.0 keV have been found to decay with the 30 min period of ^{178}Lu. A decay scheme of ^{178}Lu has been proposed with the excited levels in ^{178}Hf at 93.17(2^+), 306.59(4^+), 1309.7(0^+,1^+), 1362.7(0^+,1^+,2^+), 1434.2(0^+), 1442.9(0^+), 1496.7(2^+), 1514.2(2^+), 1562.0(2^+), 1772.1(0^+,1^+,2^+), and 1823.2(0^+,1^+,2^+) keV. The weak β-branching ratios and their log ft values are deduced from the observed γ-ray intensities and results thus obtained are discussed. (auth) (Canada)

25740 g-FACTOR MEASUREMENT OF THE 206 keV $^9/_2^-$ STATE OF ^{187}Re. Nigam, A. K.; Bhattacharyya, R. (Saha Inst. of Nuclear Physics, Calcutta). Nucl. Phys.; A164: 411-16 (1971).

The nuclear g-factor of the 206 keV $^9/_2^-$ state ($T_{\frac{1}{2}}$ = 0.55 μs) in ^{187}Re has been measured using the differential angular correlation method and a magnetic field of about 3100 ± 30 G. The g-factor of this state comes out to be g = 1.04 ± 0.04. The angular correlation measurements on the 72–134 keV and 552–134 keV cascades were also performed. (auth)

25741 CHARGE DISTRIBUTION OF THE EVEN Nd ISOTOPES. Heisenberg, J. H.; McCarthy, J. S.; Sick, I.; Yearian, M. R. (Stanford Univ., Calif.). Nucl. Phys.; A164: 340-52 (1971).

High-energy electron scattering has been used to deduce the nuclear charge distribution of the isotopes ^{142,144,146,148,150}Nd. The measured cross sections have been fitted using a two- and a three-parameter Fermi shape. A significant increase of the surface thickness between ^{142}Nd and ^{150}Nd is observed. The data for ^{142}Nd at high momentum transfer can only be fitted by introducing a modification on the charge distribution which is due to shell-model effects. (auth)

25742 DELAYED GAMMA-RAY EMISSION IN THE SPONTANEOUS FISSION OF ^{252}Cf. Ajitanand, N. N. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nucl. Phys.; A164: 300-6(1971).

The delayed γ-ray emission in ^{252}Cf spontaneous fission has been studied using a Ge(Li) detector. In the time range 300 ns to 5 μs after fission a number of γ-rays were seen and their half-lives and intensities were measured. The results are compared with a recent investigation which used a different experimental method. (auth)

25743 EXCITED STATES IN ^{108}Pd FROM THE DECAY OF 2.42 min ^{108}Ag. Okano, K.; Kawase, Y.; Uehara, S.; Hayashi, T. (Kyoto Univ.). Nucl. Phys.; A164: 545-51(1971).

Excited states and γ-transitions in ^{108}Pd have been studied through the decay of 2.42 min ^{108}Ag. Eleven γ-ray lines were observed altogether, including six previously unreported lines. The electron capture and positron transitions have been newly

confirmed to lead to levels in ^{106}Pd at 433.9 ± 0.3, 930.9 ± 0.7, 1052.8 ± 0.4, 1314.1 ± 0.4, 1441.1 ± 0.3 and 1540.0 ± 0.4 keV in addition to the transition to the ground state. Gamma-gamma angular correlation measurements have established the spins of levels at 1052.8 and 1441.1 keV as 0 and 2, respectively. The 1007.2 keV transition from the 1441.1 keV level to the 433.9 keV first excited state has been found to be M1 + (5.3 ± 1.4)% E2 with $\delta = -0.24 \pm 0.04$. The experimental results are compared with the predictions for vibrating spherical nuclei. (auth)

25744 CONFIRMATION OF THE EXISTENCE OF A 2044.1 keV STATE IN ^{102}Ru. Taylor, H. W.; Singh, B. (Univ. of Toronto). Can. J. Phys.; 49: 281-3(15 Jan 1971).

The primary transitions deexciting a 2044.1 keV level in ^{102}Ru proposed earlier were observed in singles and coincidence spectra, confirming the existence of the level. From a comparison of the population and decay modes of this state with those of the nearby 2^+ state at 2037.5 keV, the spin-parity of the 2044.1 keV state is inferred to be 3^-. (auth) (Canada)

25745 STUDY OF THE RADIATIONS EMITTED IN THE DISINTEGRATION OF ^{107}In. Rivier, Janine; Moret, Roger (Univ., Grenoble, France). Compt. Rend., Ser. B; 271: 354-6(3 Aug 1970). (In French).

The study of the γ radiation and conversion electrons involved in the $^{107}_{49}$In → $^{107}_{48}$Cd disintegration led to the discovery of new transition levels in the de-excitation of ^{107}In and to the determination of certain characteristics of the nuclear level scheme of ^{107}Cd. (auth) (France)

25746 FORM OF THE SPECTRUM AND THE ANALYSIS OF THE $0^- \rightarrow 0^+$ AND $0^- \rightarrow 2^+$ TRANSITIONS OF ^{166}Ho → ^{166}Er. Liaud, Pierre; Perales, Francois (Univ., Grenoble, France. CEN, Grenoble, France). Compt. Rend., Ser. B; 271: 350-3 (3 Aug 1970). (In French).

A variation from the unique form of the transition spectrum $0^- \rightarrow 2^+$ of ^{166}Ho → ^{166}Er was found. The variation could be explained using the Buerhing formalism. The form factor for the $0^- \rightarrow 0^+$ transition was measured. The experiment was in good agreement with the theoretical form predicted by Buerhing. (auth) (France)

25747 LINEAR POLARIZATION MEASUREMENTS ON ISOTROPIC GAMMA-RAY ANGULAR DISTRIBUTIONS. Green, P. W.; Robertson, B. C.; Sheppard, D. M. (Univ. of Alberta, Edmonton). Nucl. Instrum. Methods; 92: 329-31(1971).

Measurement of the angular distribution of γ-ray linear polarization is shown in many cases to yield information about the spin and parity of the de-exciting nuclear level and the mixing ratio of the radiation when the polarization-insensitive angular distribution of the γ-rays is isotropic. Applicability of the method is discussed, and values of the polarization for several spin combinations are tabulated. (auth)

25748 LEVELS OF ^{168}Yb APPEARING IN ^{168}Lu DECAY. Arl't, R.; Gromov, K. Ya.; Malek, Z.; (and others) (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: 713-18(Apr 1970). (In Russian).

The γ and β^+ spectra of ^{168}Lu were studied. Positron spectra with end-point energies of 2.7 ± 0.3 and 1.5 ± 0.3 MeV were found. A decay scheme for ^{168}Lu is discussed. (R.V.J.)

25749 DECAY SCHEME OF SHORT-LIVED NEUTRON DEFICIENT ISOTOPES OF Sm AND Pm. NEW ISOTOPE ^{141}Sm. Arl't, R.; Baier, G.; Muziol, G.; (and others) (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: 754-67(Apr 1970). (In Russian).

Two new short-life samarium isotopes with the mass number 140 and 141 were discovered by multiple separation of neodymium daughter isobars by E. P. Kherrmann et al. (Preprint P-2647 JINR, Dubna, 1966). Half-lives of 13.7 and 22.5 min were determined by measuring half-lives of daughter isobars and extrapolating the obtained curves to the separation moment. An attempt was made to obtain additional data on the decay periods of ^{140}Sm and ^{141}Sm. Decay schemes were developed for ^{140}Sm and ^{141}Sm and ^{142}Sm which was in radioactive equilibrium with ^{142}Pm. The decay chain ^{142}Sm $\xrightarrow{73\ \text{min}}$ ^{142}Pm $\xrightarrow{40\ \text{sec}}$ ^{142}Nd was analyzed. (R.V.J.)

25750 LEVEL SCHEMES OF ^{136}Ba AND ^{138}Ba FOR (nγ) REACTIONS. Groshev, L. V.; Dvoretskii; Demidov, A. M.; Rakhimov, A. S. (Inst. of Atomic Energy, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: 768-76(Apr 1970). (In Russian).

Gamma ray spectra from transitions in ^{136}Ba and ^{138}Ba following neutron capture in ^{135}Ba and ^{137}Ba were measured using a γ-spectrometer with a Ge(Li) detector. The spectrum from a natural mixture of barium isotopes was measured using a germanium detector and a magnetic Compton spectrometer. The level schemes and transitions are discussed. (tr-auth)

25751 DECAY SCHEMES FOR ^{183}OS AND ^{183*}Os. Akhmadzhanov, A. I.; Broda, R.; Valyus, V.; (and others) (Joint Inst. for Nuclear Research, Dubna, USSR. Tashkent State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: 740-53(Apr 1970). (In Russian).

Spectra of conversion electrons, γ rays, and $\gamma\gamma$-coincidences during ^{183}Os and ^{183m}Os decay were studied using a γ spectrograph with homogeneous magnetic field, a β spectrometer of the $2\pi\sqrt{2}$ type, and a γ spectrometer with Ge(Li) detectors. Data obtained reveal 46 previously unknown transitions. The multipole order of transitions was determined for the most of the transitions. Thirteen new levels were introduced into the suggested decay schemes, most of which were confirmed by experiments with $\gamma\gamma$ coincidences. (tr-auth)

25752 DECAY SCHEME OF ^{182}Os. Akhmadzhanov, A. I.; Broda, R.; Valyus, V.; (and others) (Joint Inst. for Nuclear Research, Dubna, USSR. Tashkent State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: 777-90(Apr 1970). (In Russian).

Data are given on spectra of conversion electrons, γ-rays, γ-γ-coincidences, and the scheme of ^{182}Os decay. The data on the excited states of ^{182}Re were correlated to published data. (R.V.J.)

25753 COEFFICIENTS OF INTERNAL CONVERSION ON K-SHELL IN THE RANGE OF ENERGY TRANSITIONS FROM 1 TO 9 Mev. Trusov, V. F. (Latvian State Univ., Riga). Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: 791-5(Apr 1970). (In Russian).

Tabulated data are given for coefficients of K-shell internal conversion for 18 atoms, with Z = 60, 62, 64 ... 94 for 17 energy values at 1 to 9 MeV and initial two multipole orders of electric and magnetic transitions. (tr-auth)

25754 INTERNAL CONVERSION ELECTRONS OF HIGH ENERGIES EMITTED BY ^{150}Sm AND ^{158}Gd IN (nγ) REACTIONS. Panin, Yu. N.; Pelekhov, V. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: 804-12(Apr 1970). (In Russian).

The hard section of conversion electron spectra appearing during the capture of thermal neutrons by ^{149}Sm and ^{157}Gd was measured with a resolving power of 0.38% starting at 5 MeV using a magnetic spectrometer. Data were obtained on the multipole order of several transitions. (tr-auth)

25755 STUDIES OF THE ^{140}Ce LEVELS EXCITED DURING DECAY OF ^{140}La AND ^{140}Pr. Kalinnikov, V. G.; Ravn, Kh. L.; Khansen, P. G.; Lebedev, N. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: 916-26(Apr 1970). (In Russian).

Gamma radiation emitted during ^{140}La and ^{140}Pr decays was measured by Ge(Li) detectors. Various previously unknown γ-transitions were discovered. Two new states of 2533.4 ($1,2^+$) and 3016.9 (0^+) keV were introduced into the scheme of ^{140}Ce levels. Characteristics of the following states: 2348.19 (2^+), 2350.5 (5^+), 2464.32 ($T_{\frac{1}{2}} = 6 \times 10^{-14}$ sec), 2516.10 (4^+), 2521.72 (2^+), 2899.7 (2^+), 3498 keV ($3,4^+$) were verified. The level scheme for ^{140}Ce was correlated with the theoretical spectrum by various methods. (R.V.J.)

25756 NEW DATA ON THE LEVEL SCHEME OF ^{116}Cd. Kovrigin, O. D.; Peker, L. K.; Sychikov, G. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: 894-900(Apr 1970). (In Russian).

A double-focusing magnetic spectrometer was used for measuring the spectrum of internal conversion electrons in the β^+, ϵ decay of the ^{116*}In isomer with $T_{\frac{1}{2}} = 4.9$ hr. A series of new transitions were found and decay scheme for ^{116*}In was constructed. An analysis of the levels revealed two-particle and four-particle states of ^{116}Cd. (tr-auth)

25757 NUMBER OF FISSION CHANNELS AND INTERPRETATION OF THE ENERGY DEPENDENCE OF THE (d,p) REACTION PROBABILITY. Vorotnikov, P. E. (Inst. of Nuclear Energy, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: 888-93(Apr 1970). (In Russian).

An analysis was made of the methods for determining the number of fission channels. It was found that the energy dependence of the fission probability of ^{239}Pu by deuterons and of analog nuclei may be described by resonance maximums of the fission width related to the quasi-stationary states of the fission nuclei. The width states are of several hundreds keV and the distance between them was nearly 0.7 MeV. These states were also observed in the cross section of (dp) reactions up to excitation energies exceeding the fission barrier by 1.5 MeV and cannot be explained by the peculiarities of the barrier shape. Certain properties of quasi-stable states were examined and their relation to the stable octupole deformation before fission was postulated. (tr-auth)

25758 LONG-LIVED ISOMER STATES OF ^{200}Pb, ^{198}Pb, AND OTHER NUCLEI. Peker, L. K.; Vorob'ev, V. D. Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: 879-80(Apr 1970). (In Russian).

The decay scheme of ^{198}Bi to levels of ^{198}Pb was developed and it is shown that ^{198}Pb and ^{200}Pb should have long-lived isomeric states with $I^{\pi} = 9^-$. (tr-auth)

25759 ANOMALOUS ISOMER OF ^{101}Tc. Peker, L. K.; Sigalov, V. M. Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: 881-2(Apr 1970). (In Russian).

It is shown that anomalous levels with $5/2^-$ in ^{101}Tc isotopes exhibit some singularities which agree with the Ikegami and Sano model (i.e., they are complex and strongly collectivized states). Such levels result in anomalous isomerism of isotopes $\geq^{101}$Tc. (tr-auth)

25760 ONE OF THE FRAGMENTS OF FISSION: THE ISOMER ^{136}Xe. Peker, L. K. Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: 877-8(Apr 1970). (In Russian).

Data obtained showed that the T = 3.4 μsec isomer uncovered in the fission fragments represents the excited level of ^{136}Xe with $I^{\pi} = 6^+$. (R.V.J.)

25761 NEW DATA ON THE LOWER EXCITATION LEVELS OF ^{225}Ra. Tret'yakov, E. F.; Tret'yakova, N. I.; Konyaev, V. F.; (and others) (Inst of Theoretical and Experimental Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: 856-64(Apr 1970). (In Russian).

Studies were made of spectra for e^- and γ radiation produced by α decay of ^{229}Th. The level scheme for ^{225}Ra is discussed. (tr-auth)

25762 GAMMA RADIATION OF ^{99}Rh. Anton'eva, N. M.; Grigor'ev, E. P.; Protasova, L. F. (Leningrad State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: 865-76(Apr 1970). (In Russian).

A semiconductor Ge(Li) detector was used for measuring the population of levels during decay of both isomers of ^{99}Rh. Energies and relative intensities of γ rays for ^{99}Rh ($T_{\frac{1}{2}}$ = 16.1 days and 4.7 ± 0.1 hr) are tabulated and the decay schemes are analyzed. (R.V.J.)

25763 LIFETIME OF THE 115.6 keV STATE IN ^{146}Eu. Koksharova, S. F.; Sergeev, V. O.; Tishkin, P. A. (Leningrad State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: 835-9(Apr 1970). (In Russian).

The decay scheme of ^{146}Gd → ^{146}Eu has been studied previously. An attempt was made to reevaluate the properties of the low-level state 115.6 keV. The probabilities of the M-1 and M-2 components in the 115.6-keV transition were analyzed. (R.V.J.)

25764 LEVELS OF ^{146}Nd EXCITED DURING (nγ) REACTIONS. Berzin, Ya. Ya.; Kruminya, A. E.; Prokof'ev, P. T. Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: 824-7(Apr 1970). (In Russian).

A beta-spectrometer was used for studying the spectrum of conversion electrons emitted in the ^{145}Nd(n,γ)^{146}Nd reaction. Twenty eight transitions were seen at energies ranging from 60 to 2000 keV. The data and the previous γ ray measurements were used for supplementing the ^{146}Nd level scheme with 999.1 keV 0^+, 1376.0 keV 1^-, and 1473.0 keV 2^+ levels as well as with other levels of yet unknown characteristics. (tr-auth)

25765 STUDIES OF γ-SPECTRA FOR THE CHAIN ^{134}Ce → ^{134}La → ^{134}Ba. Abdurazakov, A. A.; Gromov, K. Ya.; Islamov, T. A.; Sabirov, B. (Joint Inst. for Nuclear Research, Dubna, USSR. Tashkent State Univ., USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: 734-9(Apr 1970). (In Russian).

A semiconductor Ge(Li)-γ-spectrometer was used for studying γ rays appearing during the decay ^{134}Ce → ^{134}La → ^{134}Ba. A series of new transitions were uncovered, and data on previously known energies and intensities were verified and corrected. A decay scheme for ^{134}La was constructed. (tr-auth)

25766 COLLECTIVE LEVELS IN ^{168}Er EXCITED BY (nγ) REACTION. Prokof'ev, P. T.; Rezvaya, G. L. Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: 719-33(Apr 1970). (In Russian).

Conversion electron spectra at 80 to 33,000 keV energies were studied using a β spectrograph with the resolving power of 0.1 to 0.3%. Data obtained and data on spectra of γ-rays emitted during thermal and resonance neutron capture by ^{167}Er nuclei were used for supplementing the ^{168}Er level scheme with rotational bands $K^{\pi} = 0^+$ (1215.0 keV), 0^- (1353.9 keV), and 2^- (1569.1 keV). The energies for the levels are close to the theoretical values calculated according to the superfluid nuclear model. For gamma-vibration band mixing with the main rotation band, the mixing parameter $z_2 = 0.033$ was studied. (tr-auth)

25767 STUDY OF NUCLEAR REACTION BY MEANS OF RESIDUAL NUCLEUS METHOD. Oka, Yoshinaga; Nomura, Koichi; Saito, Tatsuya; Tsai, Hui-tuh; Sato, Takeo (Tohoku Univ., Sendai). Kakuriken Kenkyu Hokoku; 2: 123-9(Dec 1969). (In Japanese).

The following four investigations were carried out. (I) The integrated cross section for (γ,n) reaction induced by 250 MeV-bremsstrahlung. When the yield of photonuclear spallation reactions is investigated, the yield of produced individual nuclides is obtained as the relative value to the yield of the (γ,n) reaction of the corresponding parent nuclide. In this paper, the yield, with the (γ,n) reaction taken as the basis, was measured for fourteen nuclides. (II) The yield of ^{127}I(γ,xn)$^{120-126}$I and ^{55}Mn(γ,4pxn)$^{43-48}$Sc reactions. The relation between the yield and the number of emitted neutrons (x) and its dependence on the energy of bremsstrahlung were investigated for ^{127}I(γ,xn)$^{120-126}$I and ^{55}Mn(γ,4pxn)$^{43-48}$Sc reactions. (III) The yield of ^{133}Cs(γ,2pxn)$^{120-131}$I reactions. The same experiment as (II) was carried out for ^{133}Cs(γ,2pxn)$^{120-131}$I reactions. (IV) The ratio of formation of nuclear isomers due to (γ,n) reactions. (Japan)

25768 HYPERFINE INTERACTIONS AND NUCLEAR STRUCTURE. Levanoni, Menachem. Pasadena, Calif.; California Inst. of Tech. (1970). 156p. University Microfilms Order No. 70-24,574.

Thesis.

The gamma–gamma perturbed-angular-correlation technique was used to measure magnetic dipole moments of several nuclear excited states in the osmium transition region. In addition, the hyperfine magnetic fields, experienced by nuclei of "impurity" atoms embedded in ferromagnetic host lattices, were determined for several 4d and 5d impurity atoms. The following magnetic dipole moments were obtained in the osmium transition region: $\mu_{2+}(^{190}Os) = 0.54 \pm 0.06$ nm, $\mu_{4+}(^{190}Os) = 0.88 \pm 0.48$ nm, $\mu_{2+}(^{192}Os) = 0.56 \pm 0.08$ nm, $\mu_{2+}(^{192}Pt) = 0.56 \pm 0.06$ nm, and $\mu_{2+}'(^{192}Pt) = 0.62 \pm 0.14$ nm. These results are discussed in terms of three collective nuclear models: the cranking model, the rotation–vibration model, and the pairing-plus-quadrupole model. The measurements are found to be in satisfactory agreement with collective descriptions of low-lying nuclear states in this region. The following hyperfine magnetic fields of "impurities" in ferromagnetic hosts were determined: H_{int}(Cd Ni) = −(64.0 ± 0.8) kG, H_{int}(Hg Fe) = −(440 ± 105) kG, H_{int}(Hg Co) = −(370 ± 78) kG, H_{int}(Hg Ni) = −(86 ± 22) kG, H_{int}(Tl Fe) = −(185 ± 70) kG, H_{int}(Tl Co) = −(90 ± 35) kG, H_{int}(Ra Fe) = −(105 ± 20) kG, H_{int}(Ra Co) = −(80 ± 16) kG, and H_{int}(Ra Ni) = −(30 ± 10) kG. No quantitative theory is available for comparison. However, these results are found to obey the general systematics displayed by these fields. Several mechanisms that may be responsible for the appearance of these fields are mentioned. Finally, a theoretical expression for time-differential perturbed angular correlation measurement, which duplicates experimental conditions, is developed, and its importance in data analysis is discussed. (Diss. Abstr. Int., B)

25769 TRANSITION RADIATION IN DOMAIN OF RESONANCE γ QUANTA. Perelshtein, E. A.; Podgoretskii, M. I. Yadern. Fiz.; 12: 1149-53(Dec 1970). (In Russian).

The effect of nuclear absorption lines on the transition radiation of resonance γ quanta from the penetration of relativistic electrons through a layer of a finite thickness is considered. It is shown that the radiation intensity inside the absorption line may be essentially more than the intensity outside the line. (auth)

25770 CONTRIBUTION TO THE STUDY OF ^{115}In BY NUCLEAR PHOTOACTIVATION. Boivin, Michel; Zecevic, Vasco (Univ., Paris). Compt. Rend., Ser. B; 271: 386-8(10 Aug 1970). (In French).

A study was made of indium 115 by nuclear photoactivation. The energies of some nuclear levels previously observed were refined and new levels were discovered by this method. The corresponding cross sections were calculated and probable characteristics were given. (auth) (France)

25771 DIFFERENTIAL CROSS SECTIONS OF SMALL-ANGLE NEUTRON SCATTERING AND NEUTRON POLARIZABILITY. Anikin, G. V.; Kotukhov, I. I. Yadern. Fiz.; 12: 1121-31(Dec 1970). (In Russian).

Results of measurements of neutron cross sections within the angles 2.5 to 25° are given. The differential cross sections (relative values) for U, Pb, and Cu are given. The comparison of the experimental angular distributions with those calculated in the framework of the optical model shows that the agreement may be considerably improved by introducing a small addition to the nuclear potential that corresponds to a neutron polarizability of the order 2×10^{-40} cm^3. (auth)

25772 EVIDENCE FOR AN ISOMERIC $29/2^+$ LEVEL IN ^{211}At. Bergstroem, I. (Forskningsinstitutet foer Atomfysik, Stockholm); Fant, B.; Herrlander, C. J.; Wikstroem, K.; Blomqvist, J. Phys. Scr.; 1: 243-5(1970).

A 70-ns isomeric state at 2,641 keV has been produced in the ^{209}Bi(α,2n)^{211}At reaction and interpreted as the $29/2^+$ state of the $h_{9/2}^2 i_{13/2}$ proton configuration. It decays to the states $(h_{9/2}^2 f_{7/2})_{13/2}$, $(h_{9/2}^2)_{9/2}$, $(h_{9/2}^2)_{13/2}$ and $(h_{9/2}^2)_{9/2}$ by a straight cascade of transitions with energies (multipolarities) 713.3 keV (E3), 511.6 keV (M1), 96.0 keV (E2), 253.4 keV (E2), and 1,066.9 keV (E2). There is also indirect evidence for a 24.4-keV (E2) branch to a $(h_{9/2}^2 i_{13/2})_{25/2}$ state followed by a 688.9-keV (E1) transition to the $21/2^-$ state. The reduced transition rate B(E3, $29/2^+ \rightarrow 23/2^-$) = 51,000 e^2fm^6 can be reproduced by taking the value 0.9 MeV for the particle–phonon coupling matrix element $\langle j_{13/2}, 3^-; 7/2|H_{coupl}|f_{7/2}\rangle$. (auth) (Sweden)

25773 TRANSITION PROBABILITIES OF EXCITED NUCLEAR STATES IN ^{133}Cs. Vaelivaara, K. G.; Marelius, A.; Kozyczkowski, J. (Uppsala Univ.). Phys. Scr.; 2: 19-22(1970).

The lifetimes of the excited states in ^{133}Cs have been measured by the delayed-coincidence technique. The following half-lives were measured for the different levels: 81.0 keV: $T_{1/2} = 6.27 \pm 0.04$ ns; 160.5 keV: $T_{1/2} = 190 \pm 15$ ps; 384 keV: $T_{1/2} = 40 \pm 20$ ps; 437 keV: $T_{1/2} \leq 150$ ps. A comparison is made between experimental and theoretical transition probabilities. The 160-keV state is interpreted as a three-quasi-particle state. (auth) (Sweden)

25774 NUCLEAR SPIN OF NEUTRON-DEFICIENT TERBIUM ISOTOPES. Aedelroth, K. E.; Nyqvist, H.; Rosen, A. (Chalmers Tekniska Hoegskola, Goteborg). Phys. Scr.; 2: 96-102(1970).

The atomic-beam magnetic-resonance method has been used to measure the nuclear spins of some neutron-deficient terbium isotopes with the following results: ^{151}Tb (18 h) I = 1/2, ^{152}Tb (18 h) I = 2, ^{153}Tb (2.4 d) I = 5/2, ^{154}Tb (9 h) I = 3, ^{154}Tb (21 h) I = 0, ^{155}Tb (5.6 d) I = 3/2, ^{156}Tb (5.4 d) I = 3. The spin values are compared with spectroscopic results and discussed in terms of the unified nuclear model. (auth) (Sweden)

25775 EMPIRICAL PENETRABILITY COEFFICIENTS OF HEAVY NUCLEI FOR 0.05- TO 2-MeV NEUTRONS. Vorotnikov, P. E. At. Energ. (USSR); 29: 48-50(Jul 1970). (In Russian).

In order to calculate neutron reactions with heavy nuclei including compound-nucleus formation it is necessary to know the penetrability coefficients T_l, where l is the orbital moment of the incident neutron. Ordinarily, values of T_l are calculated from some modification of an optical model of the nucleus characterized by a definite set of optical parameters. Since the optical parameters themselves are not important for many problems, it is more useful and accurate to determine values of T_l directly from experimental data for a relatively narrow region of nuclei and neutron energies. Experimental and calculated values of T_l are compared with respect to the energy dependence of the inelastic neutron scattering cross sections with excited levels 2^+, 4^+, 6^+, 1^-, 3^-, and 5^- in the ^{232}Th and ^{238}U nuclei. In the calculations it is assumed that the optical potential is the same for the ground and excited states. Nuclear fission is ignored as well as the contribution of direct processes. From the different role of separate T_l in the excitation of different levels it is possible to determine the penetrability coefficient with an accuracy of 10 to 15% including the experimental errors in the scattering experiments. Values of T_l depend only slightly on the atomic weight. The penetrability coefficient is large for f-neutrons. (TTT)

25776 METHOD FOR MEASURING RELATIVE NEUTRON CAPTURE IN ^{238}U. Sekiguchi, Yoshiyuki; Kurosawa, Fumio; Takayama, Kazuhiko (Nippon Atomic Industry Group Co., Kawasaki, Japan). J. Nucl. Sci. Technol. (Tokyo); 7: 541-2(Oct 1970).

For determining the initial conversion ratio or the resonance escape probability in ^{238}U fueled lattices, it is necessary to measure the relative neutron capture in ^{238}U. It is shown that, by measuring the γ-ray spectrum of irradiated U with a Ge(Li) detector and counting the 278-keV γ ray from ^{239}Np, the relative neutron capture of ^{238}U can be determined. The required relative fission rate can be determined by counting the 293-keV γ rays from ^{143}Ce. The advantages of this procedure are discussed. (R.W.R.)

25777 DEFENCE OF THE BERKELEY WORK ON ALPHA-EMITTING ISOTOPES OF ELEMENT 104. Ghiorso, A.; Nurmia, M.; Harris, J.; Eskola, K.; Eskola, P. (Univ. of California, Berkeley). Nature (London); 229: 603-7(26 Feb 1971).

A detailed rebuttal is made of charges by the Dubna group against the validity of the work by the Berkeley group on the discovery of two alpha-emitting isotopes of element 104 (rutherfordium) by nuclear reactions induced by high-energy particles. Each major charge is stated; and an explicit reply given. Some new evidence in support of the original work is described. It is concluded that (1) the additional experiments with ^{257}Rf described in this article confirm the original findings; (2) the puzzling transfer phenomenon is explained as the result of previously unknown isomeric transitions in the even–even nuclides, ^{250}Fm and ^{254}No; (3) the unknown 0.75- and 8.87-MeV activity is due to ^{257}Lr; (4) there is no gas leakage in the Berkeley system which could transfer activity directly to the detector faces; and (5) the system does not have a characteristic half-life due to some unexplained artefact (UK)

25778 STUDY OF NUCLEAR REACTIONS (n,2n) AND (n,γ) RESULTING IN ISOMERIC STATE OF ^{93}Mo. Gangrskii, Yu. P.; Kharisov, I. F. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 12: 1117-20(Dec 1970). (In Russian).

The cross sections of the (n,2n) and (n,γ) reactions resulting in the isomeric state of ^{93}Mo with spin $21/2^+$ were measured in the neutron energy ranges 2.5 to 3.0 and 13 to 15 MeV. Isomeric ratios in the (n,γ) reactions were found to be anomalously large. The mechanism of the population of the isomeric state through the levels of the multiplet based on the isomeric state is discussed. (auth)

25779 VIBRATIONAL NUCLEAR SPECTRA AND ANGULAR MOMENTUM PROJECTION. Frauendorf, S.; Janssen, D.; Muenchow, L. (Central Inst. for Nuclear Research, Rossendorf, Ger.). Yadern. Fiz.; 12: 1183-93(Dec 1970). (In Russian).

Projection formalism is applied to describe weakly deformed even–even nuclei. This generalization is possible due to a simple form of the overlap integrals. To establish the relation to phonons in the Tamm–Dancoff method it is necessary to determine the internal states from the variational principle after the projection is performed. The calculated spectra of the Cd isotopes are in reasonable agreement with experiment. (auth)

25780 CONTINUUM SHELL-MODEL CALCULATIONS FOR ^{208}Pb. Barrett, R. F. (Univ., Frankfurt am Main). Phys. Lett.; 34B: 110-12(1 Feb 1971).

Results of a continuum shell-model calculation of the total photoabsorption cross section for ^{208}Pb are presented and compared with the results of experiments and of bound-state calculations. (auth)

25781 WAVE FUNCTIONS FOR THE TWO-QUADRUPOLE PHONON STATES IN ^{126}Te. Loevhoeiden, G.; Skaali, B.; Christensen, P. R. (Univ. of Copenhagen). Phys. Lett.; 34B: 125-7 (1 Feb 1971).

Scattering of 13-MeV protons from two-phonon levels in ^{126}Te is interpreted in terms of the vibrational model by means of second-order DWBA theory. The extracted wave functions agree with previous (d,d') results. (auth)

25782 HOW PURE ARE THE SINGLE PARTICLE STATES IN Pb REGION. Vergados, J. D. (State Univ. of New York, Stony Brook). Phys. Lett.; 34B: 121-4(1 Feb 1971).

Normal-parity states with $j \leq 3/2$ in ^{209}Pb, ^{207}Pb, ^{209}Bi, and ^{207}Tl were studied by diagonalizing large shell-model matrices. The results confirm that, with the exception of $1/2^-$ states in ^{209}Bi, such states are of single-particle structure. (auth)

25783 DETERMINATION OF STRUCTURE OF NUCLEI BY USE OF REACTIONS WITH DEUTERONS. Nemets, O. F. Visn. Akad. Nauk Ukr. RSR; No. 7, 38-43(1970). (In Ukrainian).

The structure and properties of nuclei were studied by determining the quantum characteristics of nuclear levels from experimental data on 13.6-MeV deuteron stripping reactions (d,p) with 40 nuclei, including separated isotopes of Sr, Zr, Bi, Sn, Cu, Cr, Ni, Ti, Fe, Be, C, N, Ca, Pb, Ag, Au, Se, Nb, Cd, and Ru. In most cases the measured values of spins and parities are in good agreement with those predicted by the shell model. However, corrections were made in the order of the 1st and 2nd excitation states of ^{89}Sr, ^{91,93,95}Zr, and ^{93,95,97}Mo. The experimental study of the elastic scattering of d by more than 60 nuclei provided data for the optical-model analysis. The results lead to the establishment of discrete and continuous types of optical potentials. Experimental data were also obtained on the polarization of d by various nuclei and the stripping reactions of polarized d. The values of the vector polarization are approximately the same for all nuclei. (Selenium-Tellurium Abstr.)

25784 PROPERTIES OF PHONON-COUPLED LEVELS: THE LEVELS OF ^{135}Ba POPULATED IN THE DECAY OF ^{135}La. Bazan, F.; Meyer, R. A. (Univ. of California, Livermore). Nucl. Phys.; A164: 552-64(1971).

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The radioactive decay of ^{135}La has been studied with the aid of ordinary Ge(Li) spectrometers and Compton suppression Ge(Li) spectrometers. The levels in the deduced decay scheme are discussed in terms of the odd neutron coupled to the core vibration. Some evidence is given for the preferential decay of the levels to other phonon-coupled configurations rather than by the expected E2 phonon de-excitation mechanisms. (auth)

25785 LEVELS IN ^{171}Lu FROM THE REACTIONS ^{169}Tm(α, 2nγ)^{171}Lu AND ^{171}Yb(d,2nγ)^{171}Lu. Kemnitz, P.; Funke, L.; Hohmuth, K.; (and others) (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Nucl. Phys.; A164: 513-25(1971).

Gamma radiation following the reactions ^{169}Tm(α,2nγ)^{171}Lu and ^{171}Yb(d,2nγ)^{171}Lu has been studied using Ge(Li) detectors. Measurements of energies and intensities, $\gamma\gamma$ coincidences and angular distributions have been performed with α-particle and deuteron energies of 27 MeV and 13.5 MeV, respectively. Excitation data are derived from γ-ray intensity measurements at α-particle energies of 21, 23, 25, and 27 MeV. A level scheme is proposed involving Nilsson states $1/2^+$[404], $1/2^+$[411], $1/2^-$[541], $5/2^+$[402], and $9/2^-$[514] and rotational bands up to spin values $23/2$, $19/2$, $15/2$, $11/2$, and $11/2$, respectively. In the band $1/2^-$[541] (a $\approx$ 3) not only the low-lying sequence I + 1/2 = odd was found but also 4 levels of the disfavored sequence I + 1/2 = even. Energies of rotational states were analyzed in terms of a formula with four rotational parameters including one or two alternating sign terms for bands with K $\neq$ 1/2 or K = 1/2, respectively. The perturbation of the $1/2^-$[541] band caused by Coriolis mixing with the $3/2^-$[532] band has been evaluated. The quantities $(g_K - g_R)^2/Q_0^2$, b_0 or $(1 - b_0)^2$ $(g_K - g_R)^2/Q_0^2$ have been deduced. (auth)

25786 K^- CAPTURE IN ^{157}Gd. Chattarji, D. (Visva-Bharati Univ., Santiniketan, India). Phys. Lett.; 34B: 381-2 (15 Mar 1971)

Capture rates for K^- in ^{157}Gd are calculated by using a deformed Wood–Saxon distribution of protons and neutrons with identical distribution parameters. The result is in agreement with recent experimental observations on K-mesic x rays. (auth)

25787 ^{92}Mo(p,t)^{90}Mo REACTION AT 40 MeV. Moalem, A. (Tel-Aviv Univ., Ramat-Aviv, Israel); Moinester, M. A.; Alster, J.; Dupont, Y.; Chabre, M. Phys. Lett.; 34B: 392-4(15 Mar 1971).

By the reaction ^{92}Mo(p,t)^{90}Mo the level diagram of ^{90}Mo was obtained. The data are analyzed with a DWBA calculation in order to test simple shell-model configurations. Similarities are observed between the excitation energies and excitation of this reaction and the known ^{90}Zr(p,t)^{88}Zr reaction. (auth)

25788 INELASTIC SCATTERING OF 24.5 MeV POLARIZED PROTONS FROM ^{152}Sm. Barbier, M. P.; Lombard, R. M.; Moss, J. M.; Terrien, Y. D. (CEN, Saclay, France). Phys. Lett.; 34B: 386-8(15 Mar 1971).

Asymmetries and differential cross sections were measured for the elastic and inelastic scattering of 24.5-MeV polarized protons from ^{152}Sm. Assuming ^{152}Sm to be an axially-symmetric perfect rotor, coupled-channel calculations give good account of the experimental data. The deformation parameters determined by the theoretical analysis are in excellent agreement with those found in the 50-MeV alpha scattering analysis of Hendrie et al. (auth)

25789 MICROSCOPIC DESCRIPTION OF 2p–2h STATES IN ^{208}Pb. Vergados, J. D. (State Univ. of New York, Stony Brook). Phys. Lett.; 34B: 458-64(29 Mar 1971).

0^+ and 2^+ 2p–2h states in ^{208}Pb were studied using a realistic nucleon–nucleon interaction. The model space included both proton and neutron pairing vibrations as well as appropriate coupling of the lowest 3^- and 5^- 1p–1h states of ^{208}Pb. The calculation indicates that the resulting eigenstates do not have a simple structure. For the 0^+ states in particular the inclusion of 2np–2nh states (n > 1) was necessary. The latter were included in the framework of the quasi-boson approximation. (auth)

25790 DIRECTIONAL CORRELATION MEASUREMENTS ON THE DECAY OF ^{176}Ta. Boddendijk, H. G.; Idzenga, S.; Timmerman, G.; Verheul, H. (Vrije Univ., Amsterdam). Nucl. Phys.; A165: 441-8(1971)

Directional correlation measurements were performed on cascades occurring in the decay of ^{176}Ta to ^{176}Hf. Spins and parities, as well as K-values, were obtained for a number of levels and a comparison is made with theoretical predictions. The experiment values of the electron particle parameters $b_2(ce_L, 0.0881$ MeV) and $b_2(ce_K, 0.2010$ MeV) agree with the values calculated by Hager and Seltzer. (auth)

25791 STUDY OF THE REACTION ^{127}I(n,γ)^{128}I. Schaller, L. A.; Kern, J.; Michaud, B. (Univ. of Fribourg, Switzerland). Nucl. Phys.; A165: 415-32(1971).

The thermal neutron capture γ-ray spectrum of the ^{127}I(n,γ)^{128}I reaction has been investigated using a pair and an anti-Compton spectrometer. The energy resolution of the detection system was 5.3 keV at 5 MeV, 1.7 keV at 0.5 MeV. A neutron separation energy of 6825.7 ± 0.5 keV has been deduced by direct observation of the ground state transition as well as by sum relations. A total of 149 transitions has been observed between 4.5 and 7 MeV, and 174 transitions have been found below 1.5 MeV. A tentative low-energy level scheme is discussed on the assumption of quasiparticle excitations. (auth)

25792 ENERGY LEVELS OF ^{98}Mo EXCITED IN THE (n,γ) REACTION. Heck, D.; Fanger, U.; Michaelis, W.; Ottmar, H.; Schmidt, H. (Kernforschungszentrum, Karlsruhe, Ger.). Nucl. Phys.; A165: 327-52(1971).

The γ-ray spectra following thermal neutron capture in ^{97}Mo have been studied using Ge(Li) and NaI(Tl) detectors in various arrangements at the Karlsruhe research reactor FR-2. The target consisting of metallic molybdenum powder enriched to 92.8% in ^{97}Mo was irradiated in external beam geometry. Energies and intensities of 247 transitions in the energy range 0.15 to 2.30 MeV and 4.9 to 8.7 MeV have been determined. Coincidence relationships measured with a Ge(Li)–Ge(Li) coincidence set-up were of considerable aid in constructing a level scheme for ^{98}Mo, which includes 29 excited states and 99 transitions. The analysis of angular correlation measurements of five cascades yielded the spin values of the levels involved in these cascades and the multipole mixtures of the linking transitions. The insufficiency of existing shell-model predictions for Mo isotopes is pointed out. Analogies with the properties of some states in the neighboring ^{96}Mo isotope, as recently investigated by the present authors, are found. The discussion of the deduced levels in terms of a new collective model leads to the interpretation of ^{98}Mo as a nucleus in the transition region between vibrating spherical and rotating deformed nuclei. (auth)

25793 ^{230}Th NUCLEAR LEVEL SCHEME. Briand, Jean-Pierre; Chevallier, Pierre; Borg, Janet (Univ., Paris). Compt. Rend., Ser. B; 272: 254-7(18 Jan 1971). (In French).

The nuclear level scheme of ^{230}Th excited in the electron capture disintegration of ^{230}Pa was studied by two-dimensional γ–γ coincidences and internal conversion electron–γ coincidences. Three new quadrupole and octupole vibration levels were established, and 17 new transitions fitted into the scheme. The results are briefly discussed. (France)

Nuclear Theory

Refer also to abstracts 25451, 25456, 25642, 25663, 25684, and 25720.

25794 (BARC-512) FORMALISM FOR THE STUDY OF TWO HOLE STATES IN NUCLEI WITH THE (π^-,NN) REACTION. Jain, B. K. (Bhabha Atomic Research Centre, Bombay (India)). 1970. 33p. Dep. NTIS (U. S. Sales Only).

A formalism is developed to study two-hole states in atomic nuclei with the (π^-,NN) reaction. The interaction of the pion with the nucleus is described by a two-nucleon model. The interaction of outgoing nucleons with the residual nucleus is incorporated through the optical-model potential. The spectroscopic amplitude for the two nucleons in the nucleus is given in the LS-coupled basis states of the shell model. (auth)

25795 (HMI-B-101) THEORY OF THE NUCLEAR MODEL. First Part. Eichler, J. (Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany)). Aug 1967. 105p. (In German). Dep. NTIS (U. S. Sales Only).

The theory of the nuclear model with a purely phenomenological character is considered. The models considered clarify the properties of the nucleus and do not consider the structure of the physical system. The model should be mathematically simple to handle. The models considered are concerned with description of the energy levels and the spectroscopic properties (spin, parity, and electrical and magnetic moments). Some theoretical fundamentals are first given and the isospin formalism is developed. The electromagnetic transitions between nuclear states are then considered. The models to be discussed are the shell model, the collective model, and the Nilsson model. Only the first of these is described in the present study. (J.S.R.)

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25796 (JINR–E4-5578) CORRELATIONS BETWEEN QUASI-PARTICLE AND COLLECTIVE EXCITATIONS IN NUCLEI. Dzholos, R. V.; Rybarska, V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1971. 24p. Dep. NTIS (U. S. Sales Only).

A coupled system of equations necessary for describing the nuclear excitations is derived on the basis of the variational principle without using equations of motion. The results are illustrated by examples. (auth)

25797 (JINR–P4-5639) SEPARATION OF THE CENTER OF MASS MOTION IN TWO-PARTICLE SHELL-MODEL WAVE FUNCTION OF THE FINITE DEPTH POTENTIAL. Gareev, F. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1971. 18p. (In Russian). Dep. NTIS (U. S. Sales Only).

A method of separating the center-of-mass motion in a two-particle shell-model wave function of the finite-depth potential is suggested. The wave function of the center of mass is represented as a superposition of the Sturm–Liouville wave functions; therefore, the problem of taking into account the continuous spectrum influence does not arise. (auth)

25798 (NRCN–252) DEPENDENCE OF LIGHT PARTICLE PRODUCTION IN FISSION ON THE RATE OF CHANGE OF THE NUCLEAR POTENTIAL. Boneh, Y.; Nardi, E. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). 1970. 19p. NTIS (U. S. Sales Only).

The production of the various light nuclei emitted in fission was investigated on the basis of a model in which particle emission results from a rapid change of potential energy in the "neck" region of the fissioning nucleus. The nucleus was treated by means of a one-dimensional potential well of infinite depth. The relative emission probabilities and kinetic energies of the neutrons, protons and the other light nuclei emitted in fission were investigated as a function of the characteristic time and shape of the rising potential. (INIS)

25799 (NYO–4032-28) NUCLEAR THEORY GROUP PROGRESS REPORT, SEPTEMBER 1, 1970–AUGUST 31, 1971. Brown, G. E.; Feingold, A. M. (State Univ. of New York, Stony Brook). May 1970. Contract AT(30-1)-4032. 92p. Dep. CFSTI.

Research progress made by the Nuclear Theory Group at the State University of New York at Stony Brook in the period Sept. 1, 1969 to August 31, 1970, is reported. The studies include the nucleon–nucleon force, structure calculations in light and medium nuclei, structure calculations in the lead region, nuclear fission and fission isomers, nuclear matter and many-body problems, reaction theory, and mathematical techniques and methods. (J.W.R.)

25800 CALCULATION OF THE MOMENTS OF INERTIA FOR DEFORMED NUCLEI. Medvedev, B. I. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 13: 17-21(Jan 1971). (In Russian).

The moments of inertia of deformed nuclei at arbitrary values of the rotational moments are calculated. The results are compared with experiment. (auth)

25801 WAVE FUNCTION AND BINDING ENERGY OF ^{3}H (^{3}He) NUCLEI WITH THE ACCOUNT OF NUCLEON TENSOR INTERACTION. Dzyuba, B. M.; Pustovalov, V. V.; Rybachenko, V. F.; Sadovoi, A. A.; Efros, V. D. Yadern. Fiz.; 13: 22-31 (Jan 1971). (In Russian).

The binding energy and wave function of ^{3}H and ^{3}He nuclei are calculated using the K-harmonic method. The system of ten equations is obtained which takes into account all harmonics for the values of the global moment $K = 0, 2, 4$, and for the values of the orbital moment $L = 0, 1, 2$. The solution of five equations (with $K = 0, 2, 4$; $L = 0$; $K = 2$, $L = 2$) gives too small value of the ^{3}H binding energy for different forms and parameters of potentials as compared to calculations without tensor forces. The account of two more equations considerably increases in the absolute value the ^{3}H(^{3}He) energy. In comparison with data the admixture of the function of mixed symmetry S′ is considerably decreased; that seems to cause the problem of agreement of calculated values for the difference between charged formfactors of ^{3}H and ^{3}He and the experimental data. (auth)

25802 ANGULAR DISTRIBUTION OF INTERNAL BREMSSTRAHLUNG IN ORBITAL-ELECTRON CAPTURE FROM POLARIZED NUCLEI. Intemann, R. L. (Temple Univ., Philadelphia). Phys. Rev., C; 3: 1-10(Jan 1971).

The angular distribution of the internal bremsstrahlung accompanying allowed electron-capture transitions is calculated using the theory of Glauber and Martin. It is shown that when Coulomb effects as well as relativistic and screening corrections are taken into account, the asymmetry coefficients associated with the radiative capture of K- and L-shell electrons acquire a dependence on photon energy which is quite pronounced at energies below about $Z\alpha mc^2$. This is quite contrary to the results of previous calculations, which have predicted these coefficients to be energy independent. The present results are found to give much better agreement with recent experimental observations than that obtained with the previous theory. (auth)

25803 OFF-SHELL t MATRIX FOR THE BOUNDARY-CONDITION MODEL. Brayshaw, D. D. (Columbia Univ., New York). Phys. Rev., C; 3: 35-45(Jan 1971).

An off-shell t matrix is developed for the boundary-condition model in the general case of coupled partial waves. This development is facilitated by the use of a method for solving the Lippmann-Schwinger equation directly for potentials of the square-well type. The t matrix obtained is shown to be unique under some rather mild assumptions as to analyticity and asymptotic behavior. An integral equation of the Lippmann–Schwinger type is obtained for the t matrix in the more realistic problem of boundary condition plus external potential. (auth)

25804 BINDING ENERGY OF A Λ PARTICLE IN NUCLEAR MATTER. Ram, B.; Williams, W. (New Mexico State Univ., Las Cruces). Phys. Rev., C; 3: 45-51(Jan 1971).

The results of a complete calculation of the binding energy D of a Λ particle in nuclear matter using the method of the independent-pair approximation, which systematically take into account the second- and third-order Born corrections, are presented. It is found that these corrections are small and that the Born series converges rapidly. A comparison of our results with those obtained using other methods based on the Brueckner theory shows that they are identical. (auth)

25805 CONNECTION BETWEEN SYMPLECTIC, QUASISPIN, AND GENERALIZED BOGOLYUBOV GROUPS. Bose, A. (Univ. of Montreal); Navon, A. Phys. Rev., C; 3: 51-5(Jan 1971).

A new derivation of the quasispin groups used in nuclear spectroscopy is given. It is shown that these groups arise as the maximum commuting subgroups of the Flowers symplectic groups inside groups of generalized Bogolyubov transformations. These transformations are defined to be the most general transformations which conserve the anticommutation relations of the fermion operators of a nuclear shell. (auth)

25806 DIRECT REDUCTION TO TALMI INTEGRALS WITHOUT USE OF TRANSFORMATION BRACKETS. Richardson, R. H. (Fordham Univ., Bronx, N. Y.); Shapiro, J.; Malik, F. B. Phys. Rev., C; 3: 84-93(Jan 1971).

The two-body shell-model matrix elements for central and tensor forces can be expanded as linear combinations of Talmi integrals. A closed form, which does not involve vector-coupling coefficients or transformation brackets, is obtained for the coefficients appearing in this expansion. For the case that all the oscillator constants are the same, the result is simple enough to allow tabulation. A table of these coefficients for matrix elements involving the shell-model states 0s, 0p, and 0d is included. The main advantage of this method over the Talmi-Brody-Moshinsky method is discussed. (auth)

25807 DIFFRACTION SYSTEMATICS OF NUCLEAR AND PARTICLE SCATTERING. Frahn, W. E. (Univ. of Cape Town, Rondebosch, S. Afr.). Phys. Rev. Lett.; 26: 568-71(8 Mar 1971).

It is shown that, contrary to popular belief, diffraction scattering in nuclear and particle physics is not always of Fraunhofer type. By establishing a simple physical connection between scattering in a Coulomb field and Fresnel diffraction one can show that diffractive collisions of heavy charged particles are predominantly of Fresnel type. Quantitative criteria for Fraunhofer and Fresnel scattering, which lead to a new classification of all scattering processes, are described. (auth)

25808 RELATION OF TREIMAN–YANG ANGLE TO AZIMUTHAL ANGLE IN NUCLEAR KNOCKOUT REACTIONS. Vorob'ev, L. S.; Kolybasov, V. M.; Stolin, V. L.; Khovanskii, V. D. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 12: 1218-21(Dec 1970). (In Russian).

It is shown that in the knockout reactions at sufficiently high energies and not very large momenta of residual nucleus the Treiman–Yang angle is close to the azimuthal angle which may be expressed through angles between particle momenta in lab. system. Such a law takes place in the wide region of initial energies and may be useful in new experiments. (auth)

25809 CLASSIFICATIONS OF STATES AND INTERACTIONS IN COLLECTIVE MODEL OF NUCLEUS. Afanasev, G. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 12: 1175-82(Dec 1970). (In Russian).

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Symmetry properties of the collective model of the nucleus are analyzed. The Sp(5,5) group is taken as the noninvariance group. The result is that if the symmetry group of the Hamiltonian is SU(5) then the spectrum is vibrational, and if the symmetry group is $SO(2,1) \times R_5$, then the spectrum is rotational. (auth)

25810 ASYMPTOTICS OF THE SCATTERING AMPLITUDE WITH REARRANGEMENT IN THREE-BODY PROBLEM. Brodskii, A. M.; Potapov, V. S. (Moscow State Univ.). Yadern. Fiz.: 12: 1163-74(Dec 1970). (In Russian).

An expression is obtained for high-energy limit of the nonrelativistic three-particle scattering amplitude with rearrangement on the basis of the Faddeev-type equations by investigating the asymptotic behavior of the iteration expansion terms. (auth)

25811 NUCLEAR PARITY VIOLATION AND THE WEAK INTERACTIONS. Henley, E. M. Comments Nucl. Particle Phys.; 4: 206-10(Nov-Dec 1970).

Various experiments proposed to study parity violation in nuclei and detail questions on the self-interactions of the strangeness-changing and nonstrangeness-changing nonleptonic currents are discussed. (L.B.S.)

25812 EFFECTS OF NONLOCALITIES IN NUCLEAR OPTICAL-MODEL POTENTIALS. Scherk, Leonard R. (Univ. of Manitoba, Winnipeg). Phys. Rev. Lett.; 26: 574-8(8 Mar 1971).

It is shown that a precise account of the nonlocal aspects of the low-energy nucleon–nucleus interaction can be made by means of a simple effective-mass approximation, provided that one invokes the correct effective mass of the problem. Unlike conventional descriptions with energy-dependent local potentials, the effective-mass description is seen to involve the true geometric parameters of the interaction. (auth)

25813 K^- MESON AS A NUCLEAR-PROBE PARTICLE. Burhop, Eric H. S. Rend. Semin. Mat. Fis. Milano; 39: 102-7 (1969).

From Symposium in Honor of Giuseppe Occhialini on the 20th Anniversary of His Return to Italy, Milan, Italy. See CONF-681083.

The use of K^- mesons in studying nuclear properties is surveyed. The interpretation of the experimental observations is discussed. (J.W.R.)

25814 DOUBLE BETA DECAY. Fiorini, Ettore. Rend. Semin. Mat. Fis. Milano; 39: 108-26(1969).

From Symposium in Honor of Giuseppe Occhialini on the 20th Anniversary of His Return to Italy, Milan, Italy. See CONF-681083.

A review is presented on the problem of double beta decay. Some theoretical aspects are discussed, and the most recent experimental data is surveyed. (J.W.R.)

25815 CONVERGENCE OF CERTAIN DISTORTED WAVE APPROXIMATIONS. Edvi-Illes, C. A. (Australian National Univ., Canberra). Nucl. Phys.; A164: 385-97(1971).

Starting from a novel interpretation of the distorting potentials, a distorted-wave version of the Faddeev equations is derived. It is shown that certain distorting potentials lead to a distorted-wave expansion which is free of the singularities associated with the existence of three-particle bound states. The implications of the results for the conventional distorted wave approximation for rearrangement collisions are discussed. (auth)

25816 COLLECTIVE CONTRIBUTION TO THE NUCLEAR OPTICAL POTENTIAL. Mackintosh, Raymond S. (Australian National Univ., Canberra). Nucl. Phys.; A164: 398-410(1971).

The possible importance of collective effects on the nuclear optical potential and upon the extraction of geometrical parameters of the matter distribution is discussed. The formal problem is delimited, and an empirical study is made for some cases. (auth)

25817 STUDY OF SELF-CONSISTENT PARTICLE AND QUASIPARTICLE EQUATIONS OF MOTION. Borse, G. (Lehigh Univ., Bethlehem, Pa.); Huang, W.-C.; Kisslinger, L. S. Nucl. Phys.; A164: 422-38(1971).

Particle and quasiparticle equations of motion are studied for two- and three-particle systems. By using the exact shell-model solutions it has been possible to study in some detail the problems of truncation and spurious solutions. Three different sets of calculations are carried out to try to separate these aspects and to gain insight for a practical general formulation of the method. (auth)

25818 EFFECT OF NONLOCALITY OF NUCLEON–NUCLEON POTENTIAL ON THE TWO-BODY SUM RULES. Lilja, I. A.; Haemaelaeinen, R. M. K. (Univ. of Jyvaeskylae, Finland). Lett. Nuovo Cim.; 1: 229-32(6 Feb 1971).

A canonical transformation is done to calculate the sum rule for a system with a nonlocal potential. This sum rule is then used to study the effect of the nonlocality of the potential on the integrated photon nuclear cross section in the electric-dipole case. The integrated electric-dipole cross section for the deuteron is calculated to be 30 MeV-mb for the local potential and 44 MeV-mb for the nonlocal potential (the experimental value is 41 MeV-mb). It is concluded that the effect of nonlocality of the nucleon–nucleon interaction can be easily transformed into the coordinate operator in connection with the sum-rule calculations. One can consider that the internucleon currents that cause the nonlocality of the potential can be described by the short-range fluctuation of the nucleon coordinate or, reversibly, that the nonlocality of the potential is a natural consequence of the nonlocality of the nucleon wave packet. (R.W.R.)

25819 B.C.S.: TYPE PHASE TRANSITION IN NUCLEAR MATTER WITH $^3P_2$ PAIRING. Hoffberg, Mark Baer. New York; New York Univ. (1970). 347p. University Microfilms Order No. 71-2298.

Thesis.

Particle interactions in a fermi fluid of neutrons (or protons) are such as to attract pairs near the fermi surface more strongly in $^3P_2$ states than in the simple spherically symmetric $^1S_0$ state when the density of the fluid exceeds 1.5×10^{14} g/cm^3. Such density regimes may be realized in neutron star cores. In this case the BCS-like condensed state must be generalized not only to include triplet spin pairs, which has been done previously by Balian and Werthamer (BW) for spin independent forces, but also to include the spin dependence of the nuclear interactions. We have suitably generalized the BW formalism to take this spin dependence into account. Certain assumptions used by BW regarding the form of the energy gap matrix are explored in detail and are found to be closely related to assumptions about the behavior of the system under time reversal. The result of $^3P_2$ pair formation is an anisotropic energy spectrum for the superfluid. The rotational properties of the $^3P_2$ paired state and the significance of the anisotropy axis are discussed. The magnitude of the transition temperature ($T_c \approx .1$ MeV at $k_f = 1.4$ f^{-1}, $m^*/m = 1.0$) and the size and angular dependence of the zero temperature energy gap ($|\Delta_k^z|^2 \sim (1 + 3\cos^2\theta)$ at $k = k_f$) are obtained as functions of the density and effective mass. The transition temperature and energy gap size increase with increasing density. Though the energy gap is anisotropic, it is nodeless, leading to an exponential factor $e^{-T_0/T}$ in the specific heat. The density-current correlation function is found to vanish and the expectation value of the projection of the total angular momentum along any direction also vanishes. The energy gap for nonzero temperatures is calculated and mention is made of possible collective effects. (Diss. Abstr. Int., B)

25820 NEW THEORY OF ALPHA DECAY. Sandulescu, Aurel (Bucharest Univ. Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 15: 1105-25(1970).

Based on the Born-Casimir time-dependent perturbation method and the shell model approximations, a new formulation of alpha decay theory is given. It is shown that the alpha transitions are caused by the difference between the sums over four nucleons of the realistic and effective two-body potentials. It is concluded that the alpha decay is caused by the two-body forces which produce the clustering of four nucleons, forces which are not included in the shell model. (auth)

25821 ALPHA DECAY OF EVEN–EVEN AND EVEN–ODD SPHERICAL NUCLEI WHEN ONE OR BOTH NUCLEI ARE IN EXCITED COLLECTIVE STATES. Raduta, A. (Inst. of Atomic Physics, Bucharest); Sandulescu, A. Rev. Roum. Phys.; 15: 1073-8(1970).

Explicit expressions of the superfluid weights which appear in alpha transitions of even-even and even-odd nuclei when one or both nuclei are in excited collective 2+ states are obtained. For the calculation of the alpha superfluid weights the hypotheses were used that the superfluid properties of the initial and final nucleus are the same and that the coupling between the odd particle and the collective state is adiabatic. (auth)

25822 ASYMMETRIC INSTABILITIES IN THE LIQUID-DROP MODEL OF NUCLEAR FISSION. Gallone, S. (AGIP Nucleare, Milan); Garribba, S. Nuovo Cim.; 1A: 585-600(21 Feb 1971).

In the frame of the LDM (liquid-drop model) the potential energy of a deformed nucleus is expressed as a quadratic form of suitable deformation parameters, which describe the shape in terms of small displacements about a reference ellipsoid. Starting from this approximation, the methods and criteria for determining the equilibrium shapes are taken into consideration and the related energies determined. A stability analysis shows that sufficiently elongated shapes are actually unstable with respect to asymmetric

deformations. So a process accounting for fission-mass asymmetries may be envisaged as follows: passage through the symmetric saddle-shape configuration, subsequent elongation of the nuclear shape till the asymmetric instability comes into play, leading to the formation of unequal fragments. (auth)

25823 REALISTIC AND EFFECTIVE INTERACTIONS IN LIGHT NUCLEI. I. EFFECTIVE INTERACTION PARAMETERS OF THE 1p SHELL. Norton, John L.; Goldhammer, Paul (Univ. of Kansas, Lawrence). Nucl. Phys.; A165: 33-55(1971).

An intensive study is made of the shell-model effective interaction in the 1p shell, with particular emphasis on determining the importance of high-order G-matrix diagrams. Forty-nine levels, with principal configuration $(1s)^4(1p)^{A-4}$, are used to fit the interaction parameters. Feingold's three-body vector interaction, arising from second-order effects of the tensor force, is verified to be manifestly important in this fit. A simple four-body interaction, designed to simulate α-clustering, is also tested. The best fit obtained yields an rms deviation from experiment of 270 keV. (auth)

25824 POTENTIAL ENERGY SURFACES FOR HEAVY NUCLEI IN THE TWO-CENTER MODEL. Mosel, U. (Univ. of Tennessee, Knoxville. Oak Ridge National Lab., Tenn.); Schmitt, H. W. Nucl. Phys.; A165: 73-96(1971).

Potential energy surfaces have been calculated for heavy nuclei in the framework of the two-center model, which has here been extended to realistic nuclear shapes. These surfaces are shown in a two-dimensional representation as a function of two parameters, one of which is a measure of the elongation of the nuclear shape and the other a measure of its constriction. The surfaces are discussed in comparison with other theoretical results and experimental information. Finally the influence of fragment shells on the potential energy surface is investigated. It is found that this influence is important already at early stages of the fission process. (auth)

25825 EFFECTS OF VARIABLE INERTIA ON COLLECTIVE DYNAMICS. Hofmann, Helmut; Dietrich, Klaus (Univ., Heidelberg. Kernforschungszentrum, Karlsruhe, Ger.). Nucl. Phys.; A165: 1-18(1971).

The influence of variable inertia on bound states and on the penetrability of a potential barrier is studied in simple analytically soluble models and related to a scale transformation of the dynamical variable. It is shown that variable inertia may help to produce "shape isomers" even in the case of a very shallow "second valley" of the potential landscape. (auth)

25826 SEPARATION OF THE VARIABLES AND THE STATE OF $K^\pi = 1^+$ IN STRONGLY DEFORMED NUCLEI. Mikhailov, V. M. (Leningrad State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 34: 840-9(Apr 1970). (In Russian).

The separation of rotational variables (Euler's angles) and the coordinates of rotating nucleons were studied. Conditions were found for the best separation of variables as a condition for a Hamiltonian system with disappearance of components linear to whole angular momenta. The problem of virtual states appearing with the introduction of extra coordinates was analyzed. Conservation of the internal axis orientation results in a condition in which the states with $K^\pi = 1^+$ are distributed above the 2Δ gap. The internal axis coincides only approximately with the axis of the system. (tr-auth)

25827 EFFECT OF SPIN-DEPENDENCE PARAMETER ON EVAPORATION SPECTRUM. Ignatyuk, A. V.; Shorin, V. S. Yadern. Fiz.; 12: 1203-7(Dec 1970). (In Russian).

On the basis of the Hauser–Feshbach statistical approach the influence of σ^2 on the level density a, extracted from the neutron evaporation spectra, is considered. The explicit form of the correction to the conventional Weisskopf approximation is obtained in framework of the quasi-classical approach. (auth)

25828 VALIDITY OF THE THOMAS FERMI APPROXIMATION. Nemeth, J. (Laboratoire de Physique Nucleaire, Orsay, France); Erba, E. Gadioli. Phys. Lett.; 34B: 117-20(1 Feb 1971).

The Thomas–Fermi method is applied to calculate energies of nuclei with density-dependent effective forces. The Thomas–Fermi equations have both continuous and discontinuous solutions. From the continuous solutions the terms of the semiempirical mass formula are determined. The neutron–proton density distributions are given for the mass range A = 50 to 240. (auth)

25829 CORE-RENORMALIZATION OF THE pf-SHELL EFFECTIVE INTERACTION FOR AN RPA-DESCRIPTION OF THE CORE. Osnes, E. (Univ. of Oslo); Kuo, T. T. S.; Warke, C. S. Phys. Lett.; 34B: 113-16(1 Feb 1971).

The core-renormalization of the effective interaction between nucleons in the pf shell is found to be very much larger for an RPA description of the core than for the lowest-order perturbation-theory description. The difference between the two descriptions is much larger than in the sd shell. (auth)

25830 ISOBARIC ANALOG RESONANCES IN COLLECTIVE NUCLEI. Bledsoe, H.; Tamura, T. (Univ. of Texas, Austin). Phys. Lett.; 34B: 443-7(29 Mar 1971).

A modified theory of Fano is applied in analyzing isobaric analog resonances in highly collective nuclei. (auth)

25831 TEST OF SECOND CLASS CURRENT IN NUCLEAR BETA-DECAY. Kim, C. W. (Johns Hopkins Univ., Baltimore). Phys. Lett.; 34B: 383-5(15 Mar 1971).

As a possible test of the presence of second class currents, the measurement of angular correlations in the β decay of ^{12}B and ^{12}N is proposed. The test is free of uncertainties due to nuclear structure effects. (auth)

25832 EVIDENCE AGAINST THE EXISTENCE OF SECOND CLASS CURRENTS IN NUCLEAR BETA-DECAY. Vatai, E. (Inst. of Nuclear Research, Debrecen, Hungary). Phys. Lett.; 34B: 395-6(15 Mar 1971).

The experimental K/β^+ ratios are in contradiction with the induced tensor coupling constant, deduced from the $(ft)^+/(ft)^-$ ratios for mirror β decays. (auth)

25833 SINGLE-PARTICLE MODEL CALCULATIONS WITH POTENTIALS OF ARBITRARY SHAPES. Ehrling, G. (Research Inst. for Physics, Stockholm); Wahlborn, S. Phys. Lett.; 34B: 369-72(15 Mar 1971).

A technique of expanding arbitrary functions of two variables in separable terms is applied to nuclear single-particle potentials, and a method for high-speed calculation of the eigenstates of the Hamiltonian has been developed. The applicability of the scheme, for spherical as well as highly eccentric shapes, is demonstrated for a sequence of two-centered potentials. (auth)

25834 UPPER BOUND ON THE ERROR IN APPROXIMATE EIGENFUNCTIONS. Tewari, S. N. (Univ. of Arizona, Tucson). Phys. Lett.; 34B: 366-8(15 Mar 1971).

An expression has been derived for the upper bound on the error in approximate eigenfunctions. The expression can be conveniently used for numerical calculations with the Hartree–Fock wavefunctions. (auth)

25835 GENERALIZATION OF LOCAL AND NON-LOCAL OPTICAL MODELS. Greenlees, G. W.; Tang, Y. C. (Univ. of Minnesota, Minneapolis). Phys. Lett.; 34B: 359-62(15 Mar 1971). (COO-1265-99).

Improved local and nonlocal optical models are proposed. They contain features which are expected to arise from antisymmetrization effects as suggested by studies of light nuclear systems. These features are particularly important for describing scattering at backward angles. (auth)

25836 PHASE CONVENTIONS FOR ANGULAR MOMENTUM EIGENFUNCTIONS. Alder, K. (Univ. of Bale, Basel); Winther, A. Phys. Lett.; 34B: 357-8(15 Mar 1971).

In the present note attention is drawn to a small point concerning the choice of phases of common eigenstates of the total angular momentum operators I^2 and I_z, which are denoted by $|I,M_I\rangle$. (auth)

25837 PERTURBATION APPROACH TO THE MULTI-STEP STRIPPING ON DEFORMED NUCLEI. Lukyanov, V. K. (Joint Inst. for Nuclear Research, Dubna, USSR). Phys. Lett.; 34B: 354-6(15 Mar 1971).

The multi-step stripping cross section of deformed nuclei is calculated to all orders in the deformation parameter β. An obvious and physically clear expression is obtained. It is rather convenient for numerical applications since it is based on the usual DWBA code. In particular cases of zero and first order approximations in β it corresponds to the well-known Satchler (one-step) and the Iano and Austern (two-step) stripping formulas. (auth)

25838 MICROSCOPIC MECHANISM BEHIND THE FISSION BARRIER ASYMMETRY. Gustafsson, C.; Moeller, P.; Nilsson, S. G. (Lund Inst. of Tech., Sweden). Phys. Lett.; 34B: 349-53(15 Mar 1971).

The instability at the second saddle point of actinide elements towards asymmetric distortions is explained by a decrease in energy of the neutron orbitals [40 $\Lambda\Omega$] (orbitals at the waistline of the nucleus) for asymmetric distortions. These orbitals are situated at the Fermi surface and couple strongly to [51 $\Lambda\Omega$] levels slightly above the Fermi surface. (auth)

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25839 LOW-LYING LEVELS OF ^{12}C AND THE THREE-ALPHA PARTICLE MODEL. Visschers, J. L.; van Wageningen, R. (Vrije Univ., Amsterdam). Phys. Lett.; 34B: 455-7(29 Mar 1971).

Energies and wave functions are calculated for the 0^+ ground state and the 2^+ and 0^+ excited states of a system of three structureless alpha particles. The results are compared with the experimental levels of the ^{12}C nucleus. (auth)

25840 PROBABILITY OF α PARTICLE EMISSION DURING FISSION. Doan, T. P.; Asghar, M.; Carles, C.; Chastel, R. (Bordeaux Univ., Gradignan, France). J. Phys. (Paris); 31: 929-32(Nov-Dec 1970). (In French).

It is shown that from a knowledge of the deformation of the fragments produced in a ternary fission, the probability of α-particle emission occurring during the process can be estimated in terms of the fragment masses. Reasonably good agreement is obtained between the calculated probabilities and those experimentally measured. It is suggested that the decrease in α-particle emission observed when the fission process is very asymmetric (fragment mass ratio $R \geq 1.8$) may be due to permanent deformation of the heavy fragment. (France)

25841 THREE-BODY PROBLEM IN NUCLEAR PHYSICS. McKee, J. S. C. (Univ. of Birmingham, Eng.). Rep. Progr. Phys.; 33: 691-736(Jul 1970).

The nature of the three-body problem in nuclear physics is stated. Its solution is fundamental to a knowledge of the precise form of the nucleon–nucleon interaction. It is shown that final state interaction and nucleon–nucleon bremsstrahlung experiments can yield invaluable information on the two-body system, and can enable us to distinguish between possible models for the two-body potential. This kind of two-body information is available only from three-body experiments. Great advances in the theoretical understanding of, and in our ability to handle, the three-body system have been made since the pioneer work of Faddeev and these are discussed. The experimental state of the art is reviewed in some detail, and attention is drawn to those experiments which would appear to be the most rewarding at the present time. It is not yet possible to say the extent to which specifically three-body forces are relevant to the solution of the three-body problem. (auth) (UK)

25842 THOMAS–FERMI CALCULATIONS OF THE IMAGINARY PART OF THE OPTICAL-MODEL POTENTIAL. Cugnon, J. (Univ., Liege). Nucl. Phys.: A165: 393-400(1971).

Thomas–Fermi calculations involve a choice of the momentum distribution of the incident particle within the nucleus. Previously adopted choices are shown to be unsatisfactory. A new one is proposed which leads to an imaginary part, which is not surface-peaked. The results are very sensitive to small modifications of the distribution in the surface region. The conditions of validity are examined. (auth)

25843 MOTT–SCHWINGER POLARIZATION IN (d,p) REACTIONS. Alder, K.; Goetz, U.; Trautmann, D. (Univ. of Basel). Nucl. Phys.; A165: 433-40(1971).

The proton polarization due to the Mott–Schwinger potential has been recalculated for (d,p) reactions with energies below the Coulomb barrier. A small polarization of the order of 0.5% has been obtained. (auth)

REACTOR TECHNOLOGY

Commercial Power Reactors

Refer also to abstract 24537.

25844 (AEC-tr-7221) EXPERIMENTAL RESEARCH ON MODEL TEMPERATURE CONDITIONS OF OPERATION OF FUEL ELEMENTS OF THE BOR-60 REACTOR. Subbotin, V. I.; Zhukov, A. V.; Pashek, M.; Sviridenko, E. Y.; Ushakov, P. A.; Shulpz, V. Translation of Russian report. 22p. Dep. NTIS.

The results are presented of the experimental investigations on thermal models of the core of the BOR reactor, and of temperature fields and the thermal emission of fuel elements in the BOR reactor. An evaluation is made of the temperature nonuniformities of essential side and corner fuel elements of the assembly. 10 references. (auth)

25845 (BARC/INF-2) NUCLEAR POWERED AGRO-INDUSTRIAL COMPLEX. (Bhabha Atomic Research Centre, Bombay (India)). 1970. 9p. NTIS (U. S. Sales Only).

The concept of nuclear powered agro-industrial complex with reference to the regions of Kutch–Saurashtra and Western Uttar Pradesh is analyzed. The Kutch Saurashtra complex will consist of a 1200 MW(e) nuclear dual purpose plant for power and desalination of water, and fertilizer plants. The investment on these plants will be 5.5 billion rupees (R) and an overall return of 15.59% per annum is expected. The investment on the agricultural scheme is R.266 million and the return expected is 19.65%. The increase in GNP is estimated to be about R.1,500 million per year. The Western U. P. complex will consist of a nuclear power station of 2 × 100 MW(e) capacity supplying power to fertilizer plants, an Al plant and for energizing tube wells. The investment for the industrial portion is R.4195.5 million and return expected is 17.85%. The investments and returns for different intensities of cropping have been worked out. The problems of logistics of the two schemes have also been analyzed. It is pointed out that these schemes have very high potentialities for the economic development of the country. (INIS)

25846 (IN-1403) SIMULATED DESIGN BASIS ACCIDENT TESTS OF THE CAROLINAS VIRGINIA TUBE REACTOR CONTAINMENT. Final Report. Schmitt, R. C.; Bingham, G. E.; Norberg, J. A. (Idaho Nuclear Corp., Idaho Falls). Dec 1970. Contract AT(10-1)-1230. 203p. Dep. NTIS.

Several simulated design basis accident (DBA) tests were performed early in 1969 on the Carolinas Virginia Tube Reactor (CVTR) containment system. The final results of these DBA tests are presented, and include results of calculations of the containment heat transfer properties and comparisons of the measured and calculated containment responses to simulated DBA conditions. Steam injection conditions and flow rates, containment pressure and temperature response histories, pressure suppression spray system flow rates and effects, and a description of data acquisition instrumentation and equipment and data acquisition methods are also included. (22 references) (auth)

25847 (NP-18691) ELECTRIC POWER PRODUCTION IN SWEDEN IN THE 1970's. (Centrala Driftledningen, Vallingby (Sweden)). Nov 1962. 27p. Dep. NTIS (U. S. Sales Only).

The development of power plants in Sweden during 1960 to 1970 is reviewed. Economics related to hydro, fossil fuel, and nuclear power plants are compared. Predicted power requirements and power costs for 1970 to 1980 are presented. (D.C.C.)

25848 (NP-18721) FIFTH REPORT ON COMPETITIVE NUCLEAR ENERGY. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Dec 1969. 181p. (In Italian).

The production of electrical energy by thermal reactors, advanced converters, and breeder reactors is discussed, and the developments made in each reactor type are indicated. The availability of reactor fuels is considered. The reprocessing and fabrication of spent fuels are discussed. The present power needs of the various countries are reported and the future needs are estimated. Factors affecting the competitive costs of nuclear energy with traditional energy sources are outlined for U. K., Europe, U. S., Germany, Italy, France, and Japan. (J.S.R.)

25849 POWER PRODUCTION. Zimmerman, O. T. Cost Eng.; 14: 7-15(Oct 1969).

In 1969, electric utilities' expenditures for power-generation facilities were 55.4% for fossil-fuel plants, 13.8% for hydroelectric plants, 29.3% for nuclear plants, and 1.5% for pumped-storage plants. The trend toward nuclear plants seems to have slowed down. Hybrid plants will become more common in the future. Cost data are presented for organisations generating their own power; fossil-fuel, nuclear, TVA steam electric and pumped storage. Gas turbine systems, combination gas turbine-steam turbine plants, geothermal and sea thermal plants are included. (Fuel Abstr.)

25850 POWER REACTORS 1971. Nucl. Eng. Int.; 16: 91-118(Jan-Feb 1971).

A complete list is presented of the world's power reactors, built, under construction or planned. Tabulated sections are presented giving general information, technical data, and progress schedules. (UK)

25851 SITE ASSEMBLY OF REACTOR PRESSURE VESSELS. Webb, R. S. (Chicago Bridge and Iron, Oak Brook, Ill.). Nucl. Eng. Int.; 16: 57-9; 61(Jan-Feb 1971).

Two large steel vessels, each 500 tons, were assembled on sites at Monticello, Minnesota, and at Vernon, Vermont, the location of each site making overland delivery of such large vessels impracticable. Descriptions are given of the method of assembly and of the procedures adopted for including high quality control at all stages of the process, e.g. in specification, process control, supervision, welding inspection, and nondestructive testing. (UK)

25852 ADVANCED REACTOR SYSTEMS. Mummery, P. W. (UKAEA Reactor Group, Dounreay). pp 260-76 of Proceedings of the Seminar on Nuclear Power. /Rastogi, B. P. (ed.). Bombay; Department of Atomic Energy (1970). (CONF-700113-4).

From Seminar on Nuclear Power, Bombay, India.

U.K.'s nuclear power development program is outlined. The present position of the nuclear power installations is briefly reviewed. Reference is made to the existing advanced thermal reactors: a 100 MW(e) SGHW prototype and a MKIII GCR(HTR), and the fast reactor at Dounreay scheduled to go into operation by the end of 1972. The early considerations leading to the development of advanced reactor systems are enumerated. The need to consider appropriate reactor strategies, taking into account the technical and economic characteristics of different reactor types and fueling concepts, and the plant and new investments required, is pointed out. The recent strategy in the U.K. is the use of a sophisticated computerized analysis of the U.K. power system to predict the performance characteristics for fossil stations and various types of nuclear stations, to indicate fuel requirements and to yield relevant financial information. This type of analysis is of considerable value for the quick examination of complex interactions. Other forecasts, with a complete systems analysis, include: nuclear generating capacity, requirements of uranium for different types of reactors, annual rates of installation, and economic benefits. It is predicted that the fast reactor will wield a dominating influence in nuclear power in the near future. (INIS)

25853 THE FUTURE OF ATOMIC POWER. Nag Chaudhury, B. D. (Planning Commission, New Delhi, India). pp 277-85 of Proceedings of the Seminar on Nuclear Power. /Rastogi, B. P. (ed.). Bombay; Department of Atomic Energy (1970). (CONF-700113-5).

From Seminar on Nuclear Power, Bombay, India.

A plea is made for a well-conceived nuclear power development program for India for the next 20 to 25 yrs. It is suggested that Indian nuclear technology should be improved so as to achieve reduction in capital costs in the construction and maintenance of plants, reduction in fuel costs by adopting breeder reactors, and reduction in power generation cost by using reprocessed Pu and U. (INIS)

25854 A MIX OPTIMIZATION MODEL AND ITS APPLICATION TO THE NORTHERN GRID. Narasimhan, R.; Seshagiri, N. (Tata Inst. of Fundamental Research, Bombay). pp 100-24 of Proceedings of the Seminar on Nuclear Power. /Rastogi, B. P. (ed.). Bombay; Department of Atomic Energy (1970). (CONF-700113-6).

From Seminar on Nuclear Power, Bombay, India.

A general optimization model for the mix of plants developed to suit the power planning requirements of India during the fourth five year plans of the northern regional grid interconnecting different states is presented. Construction of the model is based on the definition of a cost function that is sought to be minimized. A mathematical formulation suitable for the application of optimization techniques is given. The optimum mix of thermal, hydro and

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nuclear plants which gives a minimum unit cost of electrical energy at the load end is determined. Six alternative schemes which may be assumed to develop by 1978 to 79 are considered. Among these, the scheme of putting up two nuclear stations of 400MW, one each in Punjab/Haryana and Western U.P., in addition to other thermal and hydro plants, appears to be the most economical, giving the lowest system cost. (INIS)

25855 PRESENT STATUS AND PROSPECTS FOR NUCLEAR POWER IN THE UNITED STATES. Ramey, J. T. (United States Atomic Energy Commission, Washington, D. C.). pp 125-45 of Proceedings of the Seminar on Nuclear Power. /Rastogi, B. P. (ed.). Bombay; Department of Atomic Energy (1970). (CONF-700113-7).

From Seminar on Nuclear Power, Bombay, India.

Some of the historical aspects of the development of nuclear power in the United States are reviewed. Some comments are made on the present status of nuclear power, particularly with regard to the success of the light water power reactors. The effort put on the advanced reactors, desalting technology, and energy centers in the U.S. is reviewed. (auth) (INIS)

25856 NUCLEAR ENERGY IN ITALY. Salvetti, C. (Comitato Nazionale per l'Energia Nucleare, Bologna, Italy). pp 146-55 of Proceedings of the Seminar on Nuclear Power. /Rastogi, B. P. (ed.). Bombay; Department of Atomic Energy (1970). (CONF-700113-8).

From Seminar on Nuclear Power, Bombay, India.

CNEN's programs for nuclear development in the next decade are reported in detail. The main projects planned are: the CIRENE heavy water reactor (35MW(e)), the fast reactor (140MW(t)) and the construction of a nuclear powered ship (80MW(t) PWR). Other programs include: ROVI organic moderated reactors for desalination with a capacity of fresh water per day from 50,000 to 200,000 m^3, EUREX-2 fuel reprocessing plant, and research and development work for uranium enrichment and fuel fabrication. Reference is made to the three existing nuclear power plants, the Latina 200MW(e)GCR, the Garigliano 150MW(e)BWR and the Trino Vercellese 247MW(e)PWR. The Italian National Electricity Board has recently awarded the contract for the fourth Italian Nuclear Plant, a 783MW(e)BWR. (INIS)

25857 INVESTIGATIONS ON THE FUTURE ROLE OF NUCLEAR ENERGY IN THE INDIAN NATIONAL GRID. Kraemer, H.; Wagemann, K.; Boettcher, A. (Kernforschungsanlage Juelich G.m.b.H., Ger). pp 78-99 of Proceedings of the Seminar on Nuclear Power. /Rastogi, B. P. (ed.). Bombay; Department of Atomic Energy (1970). (CONF-700113-2).

From Seminar on Nuclear Power, Bombay, India.

Several power systems with different nuclear and conventional plants have been analyzed under the conditions of the Indian grid systems with an optimization computer program. The load curve of a typical industrial nation has been applied and the main results are summarized. It follows that HWR will probably give the best starting conditions for the planned Indian nuclear power generating system. Dependence only on local reserves of natural U may retard the progress of the nuclear power program. It is indicated that the U stockpile available for the Indian grid systems should be increased. When optimizing the grid under the specific Indian conditions over a time period of about 30 to 40 years advanced thermal nuclear concepts as the MSBR, the HTR and the Thorium-HWR could have a good chance beside the reference concepts. They would lead to considerable savings in power generating costs as well as in foreign exchange requirements. (INIS)

25858 TASKS FOR THE INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA) DURING THE 1970's. Eklund, S. (International Atomic Energy Agency, Vienna). pp 286-300 of Proceedings of the Seminar on Nuclear Power. /Rastogi, B. P. (ed.). Bombay; Department of Atomic Energy (1970). (CONF-700113-1).

From Seminar on Nuclear Power, Bombay, India.

The International Atomic Energy Agency's role during the next few years with regard to nuclear power, technical assistance and scientific information is described. The Agency's role according to the Non-Proliferation Treaty is defined. The distribution of energy production in the world is stated to be uneven. It is shown that in the case of developing countries the nuclear power is less than 2% of the total capacity and the reasons for this are discussed. The Agency's purpose is to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity and to ensure that the assistance provided by it or at its request or under its supervision or control is not used in such a way as to further any military purposes. (INIS)

25859 PLANNING FOR NUCLEAR POWER DEVELOPMENT. Vij, K. L. (Power Economy Committee, New Delhi, India). pp 58-77 of Proceedings of the Seminar on Nuclear Power. /Rastogi, B. P. (ed.). Bombay; Department of Atomic Energy (1970). (CONF-700113-11).

From Seminar on Nuclear Power, Bombay, India.

The present position and future requirements of energy and electricity in India are studied. A large scale program of nuclear power development is necessary on long term basis in view of the limited solid and petroleum fuels in the country. For evolving a large scale nuclear power development program, detailed studies of the role of nuclear power in the future and technological approach for economic development of nuclear power and optimum utilization of the nuclear fuel resources should be undertaken by the agencies concerned with power development in the country. Substantial economics in nuclear power generation can be derived by adopting larger unit sizes but this would require closer integration of regional power systems. Peaking capacity through conventional, hydro and pumped storage schemes should be built up for complementary operation with nuclear power stations. (auth) (INIS)

25860 NUCLEAR POWER PLANTS UNDER CONSTRUCTION. Atomwirt., Atomtech.; 16: 170-4(Apr 1971). (In German).

Eight nuclear power plants are under construction in West Germany with a total output of 4,200 MW. This contrasts with six installations yielding 2,560 MW for the preceding year. Excluded from this compilation is the experimental nuclear power plant in Schleswig-Holstein, construction of which was postponed for two years in the fall of 1970 because the fixed cost contract between the reactor construction company and the utility company was cancelled. Studies are being conducted on whether development should proceed with a gas turbine in the primary circuit of a high temperature reactor or with a modification of the AVR reactor at Juelich. Characteristics of the eight reactors under construction are discussed and pertinent features are tabulated. (H.B.G.)

25861 NEW PROJECTS FOR NUCLEAR POWER PLANTS. Atomwirt., Atomtech.; 16: 175-6(Apr 1971). (In German).

For 1971, eight new power plants are projected for West Germany; whereas ten were projected for the preceding year. Six of these projects for commercial nuclear power stations are approaching the construction stage. The two prototype nuclear power stations, THTR and SNR, are also planned for start of construction during 1971 or 1972. Both characteristics and present status are discussed for seven of the projected power plants. (H.B.G.)

25862 OSKARSHAMN: SWEDEN'S FIRST COMMERCIAL NUCLEAR POWER PLANT. Fossen, N.-I. Tek. Ukebl.; 118: No. 8, 21-4(18 Feb 1971). (In Norwegian).

The background of the formation of the owner consortium is briefly described and the general power production situation in Sweden defined. A short description of the siting (illustrated by maps) is followed by a brief technical specification. Photographs illustrate the final phases of installation prior to core loading. The article concludes with short remarks on the turnkey form of contract, safety and concession formalities, fuel supply, and plant cost and power price. (Norway)

25863 URANIUM REQUIREMENTS FOR LIGHT WATER REACTORS. Schubert, A. Eugene. Mining Congr. J.; 57: 101-3 (Feb 1971).

The increasing growth of U. S. nuclear electric power generation to 1980 is forecast. Requirements of U_3O_8 for the 1970 to 1980 period are projected. (H.D.R.)

25864 USA STANDARD: CODE FOR PRESSURE PIPING; NUCLEAR POWER PLANT PIPING. ANSI B 31.7 1969. New York; American Society of Mechanical Engineers (1969). 226p. Available from American National Standards Inst., New York.

Requirements are presented for the design, materials, fabrication, assembly, erection, installation, and examination of three classes of nuclear piping systems for power plant service. The three classes indicate levels of quality required for the intended service. (H.D.R.)

25865 EXPERIENCES OF CONSTRUCTING, MANUFACTURING, AND OPERATION OF DEVICES OF THE CLEANING SYSTEM FOR HELIUM FROM A HIGH TEMPERATURE REACTOR. Koellner, Paul. Linde Ber. Tech. Wiss.; No. 28, 8-12(1970). (In German).

Facilities for reduction of the activity and the chemical purification of the He-coolant gas at the AVR-reactor are described. (INIS)

25866 FRANCO-BELGIAN TIHANGE NUCLEAR PLANT AND OTHER PLANTS IN BELGIUM. Com. Naz. Energ. Nucl., Notiz.; 16: No. 10, 111-14(Oct 1970). (In Italian).

25867 PROSPECTS FOR THE PEACEFUL USES OF NUCLEAR ENERGY IN THE SEVENTIES: THE SITUATION IN

BELGIUM. Goens, Julien R. J. (CNEN, Mol, Belg.). Com. Naz. Energ. Nucl., Notiz.; 16: No. 10, 45-56(Oct 1970). (In Italian).

Operation and Economics

25868 (DOCKET-1155-109) LA CROSSE BOILING WATER REACTOR. Unplanned Reactor Shutdown. (Dairyland Power Cooperative, La Crosse, Wis.). 24 Mar 1971. 2p. (DPC-71-6). Dep. NTIS.

The unscheduled shutdown of March 17, 1971 is discussed. Corrective maintenance and revised operation specifications for automatic mode control of the reactor feedwater pump system are described. (D.C.C.)

25869 (DOCKET-1155-110) LA CROSSE BOILING WATER REACTOR. Monthly Operating Report, January 1971. (Dairyland Power Cooperative, La Crosse, Wis.). Contract AT(11-1)-851. 32p. (DPC-851-22). Dep. NTIS.

25870 (DOCKET-1155-111) LA CROSSE BOILING WATER REACTOR. Unplanned Reactor Scram Caused by Electrical Load Rejection. (Dairyland Power Cooperative, La Crosse, Wis.). 31 Mar 1971. 10p. (DPC-71-7). Dep. NTIS.

25871 (DOCKET-50016-104) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. [Operations] Report, October 1970. (Power Reactor Development Co., Detroit, Mich.). 25 Mar 1971. 20p. (PRDC-EF-86). Dep. NTIS.

25872 (DOCKET-50016-105) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Abnormal Occurrence Report: Failure of Relay. (Power Reactor Development Co., Detroit, Mich.). 31 Mar 1971. 1p. Dep. NTIS.

The failure of a relay which controls the position of an automatic valve in the pipeline between the primary Na storage tank and the overflow tank is described. (D.C.C.)

25873 (DOCKET-50029-149) YANKEE NUCLEAR POWER STATION. Nondestructive Inservice Inspection. (Southwest Research Inst., San Antonio, Tex.). 23 Feb 1971. 53p. Dep. NTIS.

For Yankee Atomic Electric Co., Westboro, Mass.

25874 (DOCKET-50155-77) BIG ROCK POINT NUCLEAR PLANT. Roller from Control Blade Discovered During Checkout. (Consumers Power Co., Jackson, Mich.). 26 Mar 1971. 3p. Dep. NTIS.

25875 (DOCKET-50219-132) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. Main Steam Isolation Valve Testing. (Jersey Central Power and Light Co., Morristown, N. J.). 17 Mar 1971. 2p. Dep. NTIS.

25876 (DOCKET-50249-62) DRESDEN NUCLEAR POWER STATION, UNIT 3. Information Concerning a Jet Pump Problem. (Commonwealth Edison Co., Chicago, Ill.). 27 Mar 1971. 2p. Dep. NTIS.

25877 (DOCKET-50255-36) PALISADES PLANT. Demineralizer Resin Chloride Release. (Consumers Power Co., Jackson, Mich.). 6 Apr 1971. 3p. Dep. NTIS.

25878 (DOCKET-50263-60) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Omission of One Rod Group When Withdrawing Control Rods. (Northern States Power Co., Minneapolis, Minn.). 18 Mar 1971. 4p. Dep. NTIS.

25879 (DOCKET-50263-62) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Reporting of Unusual Occurrences. (Northern States Power Co., Minneapolis, Minn.). 8 Apr 1971. 6p. Dep. NTIS.

Operation incidents of March 10, March 12, March 13, March 15, March 26, 1971 are described. The March 10 incident involved the operating condition of the reactor building to suppression chamber differential pressure switch. The low condenser vacuum scram switch setpoint drift occurred on March 12. Inadequacies in the liquid radwaste release procedures are described for March 13 and March 15. On March 26 the ECCS initiating low low reactor water level switch failed to operate within the allowable deviation. (D.C.C.)

25880 (DOCKET-50266-43) POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2. Operation Report No. 1, Initial Operation through December 31, 1970. (Wisconsin Electric Power Co., Milwaukee, Wisconsin Michigan Power Co., Appleton, Wis.). 31 Mar 1971. 19p. (DOCKET-50301-29). Dep. NTIS.

25881 (DOCKET-50266-44) POINT BEACH NUCLEAR PLANT, UNIT 1. Reactor Startup Testing Summary. (Wisconsin Michigan Power Co., Appleton, Wis. Wisconsin Electric Power Co., Milwaukee). Mar 1971. 401p. Dep. NTIS.

25882 (INIS-mf-32) TECHNICAL REPORT FOR NUCLEAR POWER PLANTS. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen (West Germany)). 1970. vp. (In German). NTIS (U. S. Sales Only).

An operational report, including disturbances and radiation protection, is presented. The plant has been operated under full-load with exception of a short load decrease for carrying-out of necessary reinspection tests. Parallel to the power operation, the defective fuel element rods detected during repair operation have been investigated by use of an endoscope. So far as possible, failure pictures were made. (INIS)

25883 (KKWP-1/1970) OPERATION EXPERIENCE WITH LIGHT WATER REACTORS IN THE U. S. A. (Kernkraftwerk Planungsgesellschaft m.b.H., Vienna (Austria)). Jan 1970. 21p. (In German). NTIS (U. S. Sales Only).

In the USA, about 75% of the total nuclear power is installed in light water reactors. The operation experience of 7 boiling- and pressurized-water reactors is summarized. Special attention is given to the available time of the nuclear plant, to the causes for shut down, and to the fuel performance. Analysis of operating data shows that most of plant outages occur during the first two years. The total availability is about 70% at the end of the second year, but will rise to 90% in the following years. Future plants will have standardized components and therefore promise higher constant availabilities. (INIS)

25884 (TID-25675) GARIGLIANO NUCLEAR POWER STATION. Operation Report for the 3rd Quarter of 1970. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)). 30 Sep 1970. 20p. Dep. NTIS.

Operations and maintenance requirements during July to September 1970 are reviewed. Plant chemistry and health physics measurements are listed. (D.C.C.)

25885 (TID-25676) GUNDREMMINGEN NUCLEAR POWER PLANT. Monthly Report, December 1970. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen (West Germany)). 22 Jan 1971. 44p. (In German). Dep. NTIS.

The plant was operated on full load without restriction. The power had to be reduced briefly only for control rod reshuffling and for the repeat tests. Shipping of irradiated fuel elements to Mol continued. It was found that decontamination of the transport container was hampered by adherent road dust. The shipping of active materials in slurry form was interrupted owing to severe frost. In addition, the solid active waste was processed for disposal at Asse. The activity of the reactor water and off-gas remained constantly low. (auth)

25886 (TID-25681) GARIGLIANO NUCLEAR POWER PLANT ANNUAL REPORT, 1969. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)). 1970. 71p. Dep. NTIS.

Operations and maintenance requirements for the Garigliano Power Reactor are described. Plant chemistry and radiation monitoring measurements during March 1969 to February 1970 are presented. (D.C.C.)

25887 GENTILLY READIED FOR RUN-UP. Law, C. A. Nucl. Eng. Int.; 16: 65-8(Jan-Feb 1971).

Gentilly, the prototype CANDU-BLW, is the world's first natural U fueled, H_2O-cooled nuclear station. Its economic advantages are stressed. Topics of interest which are discussed are commissioning experience, vertical fueling, regulation and control of reactor power, fission gas release, steam quality, the use of larger fuel elements and Zr-Nb pressure tubes. (UK)

25888 DYNAMIC MODEL FOR PLANNING CAPACITY EXPANSION: AN APPLICATION TO PLANT RELIABILITY IN ELECTRIC POWER SYSTEMS. Rogers, John Scott. Stanford, Calif.; Stanford Univ. (1970). 151p. University Microfilms Order No. 71-2825.

Thesis.

A continuous-time dynamic model is presented for planning the type and timing of new capacity installations, given an existing system of plants. The new plants are chosen from a specific set of types. A type of plant is defined by its size, location, or operating characteristics. There is a one-time cost associated with the installation of a specific type of plant and a cost per unit time associated with an existing system of plants. This latter

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cost per unit time is called the system operating cost. Associated with each installation are the one-time cost, dependent upon the type of plant, and the integral of the system operating cost, discounted back to the installation time, over the time period between this installation and the next. Although the optimal installation sequence is sensitive to the price of fossil fuel, nuclear plants remain optimal for fuel prices above 26 U.S. cents per million BTU. (Diss. Abstr. Int., B)

25889 FUEL-MELTING INCIDENT AT THE FERMI REACTOR ON OCT. 5, 1966. Scott, R. L. Jr. Nucl. Safety; 12: 123-34(1971).

On Oct. 5, 1966, the Enrico Fermi 1 nuclear reactor sustained the partial meltdown of two fuel subassemblies as the result of coolant-flow blockage. It was determined that a component within the reactor vessel had vibrated loose and caused flow blockage when hydrodynamic forces carried it up to the inlet nozzle of the fuel subassemblies. Recovery operations were successful and were climaxed by full-power operation at 200 MW(t) [65 MW(e)] on Oct. 16, 1970. Many reports and articles have been written about the incident during the past 4 years, but most of these were fragmentary because the investigations and analyses had not been completed. A concise description of the incident and summary of the results of the investigations are presented. The sequence of events leading up to the incident and during the incident is reviewed; the considerations that led to understanding what had transpired are presented; and the lessons derived from the incident are discussed. 16 references. (auth)

25890 SAFETY-RELATED OCCURRENCES REPORTED IN OCTOBER–NOVEMBER 1970. Casto, W. R. (comp.). Nucl. Safety; 12: 145-7(1971).

25891 STAFFING TOMORROW'S NUCLEAR PLANTS. Deutsch, R. W. (Catholic Univ. of America, Washington, D. C.); Rizzo, A. J. Power Eng.; 75: No 3, 58-60(Mar 1971).

Reactor operator licensing requirements are reviewed. Performances of license applicants on the oral and written examinations are studied and compared. Recommendations for staffing reactor operators are presented. (D.C.C.)

25892 USA STANDARD: SELECTION AND TRAINING OF NUCLEAR POWER PLANT PERSONNEL. ANSI N 18.1D 1970. Hinsdale, Ill.; American Nuclear Society (1970). 24p. Available from American Nuclear Society, Hinsdale, Ill.

Criteria for the qualifications, responsibilities, and training of personnel for the safe and efficient operation of nuclear power plants are presented. The standard is limited to personnel who have a direct relationship to technical aspects, operation, or maintenance of the plant. (H.D.R.)

25893 NUCLEAR POWER PLANTS IN THE USA. Atomwirt., Atomtech.; 16: 150(Mar 1971). (In German).

Based on a publication of the USAEC, a survey concerning the status of nuclear power plants in the USA is given for the end of 1970. During the year, public utilities ordered 14 reactors with a total power of 14,336 MW(e). Thirteen of the ordered reactors will be installed in new power plants, the remaining one will be operated at a previously announced plant. During the preceding year, seven reactors were ordered with a total power of 7,255 MW. (tr-auth)

25894 NEW NUCLEAR POWER PLANTS IN EUROPE. PART I. CONSTRUCTION AND PROJECTS IN TEN COUNTRIES. Atomwirt., Atomtech.; 16: 138-49(Mar 1971). (In German).

Presented is an annual survey concerning the status of nuclear power plants in 10 West European countries: Belgium, Finland, France, United Kingdom, Italy, Netherlands, Austria, Sweden, Switzerland, Spain, and West Germany. Altogether, 35 power plants are now in operation with 42 reactors and 7,878 MW power; 32 plants are under construction with 38 reactors and 21,327 MW power; in the designing stage are 25 plants with 28 reactors and 21,000 MW power. With the exception of the United Kingdom, all countries now use light water reactors for their power plants, either as the boiling water or pressurized water variety. For each country, both annual progress and present status are listed. (H.B.G.)

25895 GLOBAL PRODUCTION OF ELECTRIC POWER BY NUCLEAR PLANTS DURING THE YEAR 1970. Atomwirt., Atomtech.; 16: 130(Mar 1971). (In German).

At the end of 1970, 52 power plants operating in 13 countries produced a total of 74,293,984 MWh. The power production of Russia, the People's Republic of China, and East Germany were omitted due to lack of reliable data. In a table, electrical production is specified with respect to country, reactor type, and gross electric power production for the year 1970. (H.B.G.)

25896 CASE STUDY OF LONG NUCLEAR FUEL CYCLE IN JAPAN. FROM THE REPORT OF NUCLEAR FUEL RESEARCH COMMISSION IN 1969. Shin Kinzoku Kogyo; 15: No. 4, 139-47(Apr 1970). (In Japanese).

Due to the increase of nuclear energy demand, the establishment of nuclear fuel cycle has become an important problem. The case study of long-term nuclear fuel cycle has been carried out. The calculation of the fuel cycle was carried out based on the electric power of nuclear reactors at 1970. Several necessary quantities, that is, natural uranium, enriched uranium, and fuel reprocessing were given in each year. The processing cost of fuel, cladding material and enriched uranium was also given. Results are discussed. (Japan)

Safety and Siting

25897 (BARC-524) HEALTH PHYSICS ASPECTS OF A BWR TURBINE INSPECTION. Abraham, P.; Pattnaik, D. (Bhabha Atomic Research Centre, Bombay (India)). 1971. 18p. Dep. NTIS (U. S. Sales Only).

The radiation and contamination measurements made prior to and during the inspection of a 210 MW(e) turbine at Tarapur are presented. Significant radioactive contaminants in reactor water and on the turbine internals are given. Gamma spectra of the air and smear samples collected during the inspection are presented. The processes resulting in the build-up of radioactive contamination of BWR turbines are described. The results are discussed and compared with values reported from other BWRs. Precautions necessary for overhauling radioactive turbines are mentioned. It is concluded that inspection and maintenance of BWR turbines are not likely to be hampered by radiation problems. 7 references. (auth)

25898 (DOCKET-1151-41) ELK RIVER REACTOR. Change No. 14 to the Technical Specifications of Operating Authorization No. DPRA-3. (Division of Reactor Licensing (AEC), Washington, D. C.). 6 Apr 1971. 1p. Dep. NTIS.

Revised technical specifications are presented for the use of thermoluminescent dosimeters and film badges in the facility environmental radiation monitoring program. (D.C.C.)

25899 (DOCKET-1155-108) LA CROSSE BOILING WATER REACTOR. Unplanned Reactor Shutdown. (Dairyland Power Cooperative, La Crosse, Wis.). 24 Mar 1971. 3p. (DPC-71-5). Dep. NTIS.

The unscheduled shutdown of March 9, 1971 is discussed. Corrective maintenance for the control rod drive injection flow seal is described. (D.C.C.)

25900 (DOCKET-50010-83) DRESDEN NUCLEAR POWER STATION, UNIT 1. Change No. 22 to the Technical Specifications of Facility License No. DPR-2. (Division of Reactor Licensing (AEC), Washington, D. C.). 5 Apr 1971. 5p. Dep. NTIS.

Revised technical specifications are presented for the use of Type 8 fuel assemblies during Cycle 8 operations. (D.C.C.)

25901 (DOCKET-50016-106) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Request for Technical Specifications Change No. 25. (Power Reactor Development Co., Detroit, Mich.). 2 Apr 1971. 7p. Dep. NTIS.

Revised technical specifications are presented concerning personnel qualifications and responsibilities. (D.C.C.)

25902 (DOCKET-50130-9) PATHFINDER GENERATING PLANT, SIOUX FALLS, SOUTH DAKOTA. Order Authorizing Dismantling of Facility. (Division of Reactor Licensing (AEC), Washington, D. C.). 8 Apr 1971. 3p. Dep. NTIS.

25903 (DOCKET-50130-10) PATHFINDER GENERATING PLANT, SIOUX FALLS, SOUTH DAKOTA. Change No. 20 to the Technical Specifications of the Provisional Facility License No. DPR-11. (Division of Reactor Licensing (AEC), Washington, D. C.). 8 Apr 1971. 14p. Dep. NTIS.

Proposed modified technical specifications for dismantling of Sioux Falls Power Reactor are presented. (D.C.C.)

25904 (DOCKET-50133-50) HUMBOLDT BAY POWER PLANT, UNIT NO. 3. Change No. 31 to the Technical Specifications of the Provisional Operating License No. DPR-7. (Division of Reactor Licensing (AEC), Washington, D. C.). 29 Mar 1971. 2p. Dep. NTIS.

Authorization for the use of three Jersey Nuclear fuel assemblies in the reactor core is presented. (D.C.C.)

25905 (DOCKET-50133-51) HUMBOLDT BAY POWER PLANT, UNIT NO. 3. License No. DPR-7; Technical Specifications Proposed Change No. 31. (Pacific Gas and Electric Co., San Francisco, Calif.). 25 Mar 1971. 14p. Dep. NTIS.

Revised technical specifications are presented concerning the design parameters of Type 3-3 fuel assemblies. (D.C.C.)

25906 (DOCKET-50133-52) HUMBOLDT BAY POWER PLANT, UNIT NO. 3. Change No. 32 to the Technical Specifications of the Provisional Operating License No. DPR-7. (Division of Reactor Licensing (AEC), Washington, D. C.). 8 Apr 1971. 1p. Dep. NTIS.

Authorization for deferment of operational testing of nuclear safeguards systems is presented. (D.C.C.)

25907 (DOCKET-50206-109) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Order Extending Provisional Operating License Expiration Date. (Division of Reactor Licensing (AEC), Washington, D. C.). 26 Mar 1971. 2p. Dep. NTIS.

25908 (DOCKET-50206-110) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Cycle 2 Xenon Transient Analysis. (Southern California Edison Co., Los Angeles). 29 Mar 1971. 2p. Dep. NTIS.

25909 (DOCKET-50219-127) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. Preliminary Safety Analysis Report, Amendment 61. (Jersey Central Power and Light Co., Morristown, N. J.). 4 Sep 1970. 2p. Dep. NTIS.

A request for an 18 month renewal of the provisional operating license is presented. (D.C.C.)

25910 (DOCKET-50219-130) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. Provisional Operating License DPR-16; Technical Specifications Change No. 1, Suppl. 1. (Division of Reactor Licensing (AEC), Washington, D. C.). 17 Dec 1969. 1p. Dep. NTIS.

Revised technical specifications are presented concerning extended fuel cladding safety limit. (D.C.C.)

25911 (DOCKET-50219-131) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. Provisional Operating License DPR-16; Technical Specifications Request for Wavier to Section 3.4.C. (Jersey Central Power and Light Co., Morristown, N. J.). 7 Nov 1969. 4p. Dep. NTIS.

Revised technical specifications are presented for the temporary manual control of the containment spray system during loss of auxiliary power test. (D.C.C.)

25912 (DOCKET-50244-67) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT NO. 1. Change No. 3 to Technical Specifications of Provisional Operating License No. DPR-18. (Division of Reactor Licensing (AEC), Washington, D. C.). 29 Mar 1971. 9p. Dep. NTIS.

Revised technical specifications concerning protection factors for personnel respiratory equipment are presented. Modifications for containment leak rate test requirements and environmental radiation survey program procedures are also presented. (D.C.C.)

25913 (DOCKET-50244-68) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT NO. 1. Change No. 4 to Technical Specifications of Provisional Operating License No. DPR-18. (Division of Reactor Licensing (AEC), Washington, D. C.). 5 Apr 1971. 7p. Dep. NTIS.

Revised technical specifications concerning the use of charcoal absorbers in the fuel storage area are presented. (D.C.C.)

25914 (DOCKET-50254-33) QUAD-CITIES STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 22. (Commonwealth Edison Co., Chicago, Ill. Iowa-Illinois Gas and Electric Co., Davenport, Iowa). 31 Mar 1971. 2p. (DOCKET-50265-29). Dep. NTIS.

A map of the reactor site and surrounding area is presented. (D.C.C.)

25915 (DOCKET-50254-34) QUAD-CITIES STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 21. (Commonwealth Edison Co., Chicago, Ill. Iowa-Illinois Gas and Electric Co., Davenport, Iowa). 31 Mar 1971. 37p. (DOCKET-50265-30). Dep. NTIS.

Revised and additional information is presented concerning design parameters and operations aspects of the Quad Cities Power Reactor Units 1 and 2. (D.C.C.)

25916 (DOCKET-50261-54) H. B. ROBINSON UNIT NO. 2. Facility Operating License No. DPR-23; Technical Specifications Change No. 2. (Division of Reactor Licensing (AEC), Washington, D. C.). 1 Apr 1971. 6p. Dep. NTIS.

For Carolina Power and Light Co., Raleigh, N. C.

Revised technical specifications are presented concerning the use of respiratory protective equipment. (D.C.C.)

25917 (DOCKET-50263-61) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Change Request No. 2: Gaseous Radwaste System Modification Report. (Northern States Power Co., Minneapolis, Minn.). Mar 1971. 42p. Dep. NTIS.

25918 (DOCKET-50265-31) QUAD-CITIES STATION, UNIT NO. 2. Order Extending Provisional Construction Permit Completion Date. (Division of Reactor Licensing (AEC), Washington, D. C.). 12 Apr 1971. 5p. Dep. NTIS.

25919 (DOCKET-50266-45) POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2. Safety Evaluation, Addendum No. 1. (Division of Reactor Licensing (AEC), Washington, D. C.). 24 Mar 1971. 4p. (DOCKET-50301-30). Dep. NTIS.

25920 (DOCKET-50271-42) VERMONT YANKEE NUCLEAR POWER STATION. Environmental Monitoring Report No. 1, July-October 1969. (Eberline Instrument Corp., Santa Fe, N. Mex.). 30 Mar 1971. 39p. Dep. NTIS.

For Vermont Yankee Nuclear Power Corp., Rutland.

25921 (DOCKET-50271-43) VERMONT YANKEE NUCLEAR POWER STATION. Environmental Monitoring Report No. 2, October-December 1969. (Eberline Instrument Corp., Santa Fe, N. Mex.). 30 Mar 1971. 24p. Dep. NTIS.

For Vermont Yankee Nuclear Power Corp., Rutland.

25922 (DOCKET-50271-44) VERMONT YANKEE NUCLEAR POWER STATION. Environmental Monitoring Report No. 3, January-March 1970. (Eberline Instrument Corp., Santa Fe, N. Mex.). 30 Mar 1971. 27p. Dep. NTIS.

For Vermont Yankee Nuclear Power Corp., Rutland.

25923 (DOCKET-50271-45) VERMONT YANKEE NUCLEAR POWER STATION. Environmental Monitoring Report No. 4, April-June 1970. (Eberline Instrument Corp., Santa Fe, N. Mex.). 30 Mar 1971. 25p. Dep. NTIS.

For Vermont Yankee Nuclear Power Corp., Rutland.

25924 (DOCKET-50271-46) VERMONT YANKEE NUCLEAR POWER STATION. Environmental Monitoring Report No. 5, July-September 1970. (Eberline Instrument Corp., Santa Fe, N. Mex.). 30 Mar 1971. 19p. Dep. NTIS.

For Vermont Yankee Nuclear Power Corp., Rutland.

25925 (DOCKET-50271-47) VERMONT YANKEE NUCLEAR POWER STATION. Environmental Monitoring Report No. 6, October-December 1970. (Eberline Instrument Corp., Santa Fe, N. Mex.). 30 Mar 1971. 23p. Dep. NTIS.

For Vermont Yankee Nuclear Power Corp., Rutland.

25926 (DOCKET-50271-48) VERMONT YANKEE NUCLEAR POWER STATION. Preliminary Safety Analysis Report, Amendment 23. (Vermont Yankee Nuclear Power Corp., Rutland). 31 Mar 1971. 12p. Dep. NTIS.

Financial data on the owners of the Vermont Yankee Power Reactor are presented. (D.C.C.)

25927 (DOCKET-50280-36) SURRY POWER STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 20 (Includes Additions and Revisions to Final Safety Analysis Report, Part B). (Virginia Electric and Power Co., Richmond). 1 Apr 1971. 213p. (DOCKET-50281-36). Dep. NTIS.

Revised design parameters of the Surry Power Reactor Units 1 and 2 are presented. Included also are additional data on the reactor requested by the Division of Reactor Licensing. (D.C.C.)

25928 (DOCKET-50280-37) SURRY POWER STATION, UNITS 1 AND 2. Draft Detailed Statement on Environmental Considerations. (Division of Reactor Licensing (AEC), Washington, D. C.). 22 Mar 1971. 101p. (DOCKET-50281-37). Dep. NTIS.

Information concerning chemical, radioactive, and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. (D.C.C.)

25929 (DOCKET-50285-44) FORT CALHOUN STATION, UNIT NO. 1. Preliminary Safety Analysis Report, Amendment 24 (Includes Final Safety Analysis Report, Suppl. No. 7). (Omaha Public Power District, Nebr.). 31 Mar 1971. 171p. Dep. NTIS.

Revised design parameters of the Fort Calhoun Power Reactor

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Unit 1 are presented. Included also are additonal data on the reactor requested by the Division of Reactor Licensing. (D.C.C.)

25930 (DOCKET-50309-31) MAINE YANKEE ATOMIC POWER STATION. Preliminary Safety Analysis Report, Amendment 21. (Maine Yankee Atomic Power Co., Westboro, Mass.). 30 Mar 1971. 47p. Dep. NTIS.

Additional data on the reactor requested by the Division of Reactor Licensing are presented. (D.C.C.)

25931 (DOCKET-50309-32) MAINE YANKEE ATOMIC POWER STATION. Draft Detailed Statement on the Environmental Considerations. (Division of Reactor Licensing (AEC), Washington, D. C.). 9 Apr 1971. 22p. Dep. NTIS.

Information concerning chemical, radioactive, and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. (D.C.C.)

25932 (DOCKET-50315-34) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 13. Proposed Technical Specifications and Emergency Plan. (Indiana and Michigan Electric Co., Fort Wayne, Ind.). 1 Apr 1971. 235p. (DOCKET-50316-34). Dep. NTIS.

Information concerning emergency plans for the reactor is presented. Proposed complete technical specifications are included. (D.C.C.)

25933 (DOCKET-50317-24) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Draft Detailed Statement on Environmental Considerations. (Division of Reactor Licensing (AEC), Washington, D. C.). 10 Mar 1971. 434p. (DOCKET-50318-24). Dep. NTIS.

Information concerning chemical, radioactive, and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. (D.C.C.)

25934 (DOCKET-50329-25) MIDLAND PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 20. (Consumers Power Co., Jackson, Mich.). 2 Apr 1971. 13p. (DOCKET-50330-24). Dep. NTIS.

Revised information concerning the radioactive waste disposal system is presented. Financial data on the owners of the power plant are included. (D.C.C.)

25935 (DOCKET-50334-24) BEAVER VALLEY POWER STATION. Preliminary Safety Analysis Report, Suppl. 1. (Duquesne Light Co., Pittsburgh, Pa.). 9 Mar 1971. 88p. Dep. NTIS.

Additional information on modified containment structure leak collection and filtration system is presented. Meteorological data for the site are presented for September 1969 to September 1970. Revision to the Class 1 piping system definition is included. Structures requiring earthquake resistant design specifications are listed. (D.C.C.)

25936 (DOCKET-50342-6) VERPLANCK NUCLEAR GENERATING STATION, UNITS 4 AND 5. Preliminary Safety Analysis Report, Amendment 1(Suppl.1-Pt.B): Technical Specifications. (Consolidated Edison Co. of New York, Inc., New York). 9 Apr 1971. 73p. (DOCKET-50343-6). Dep. NTIS.

25937 (DOCKET-50354-13) NEWBOLD ISLAND NUCLEAR GENERATING STATION, UNITS 1 AND 2. Environmental Report; Construction Permit Stage, Amendment 1. (Public Service Electric and Gas Co., Newark, N. J.). 26 Mar 1971. 139p. (DOCKET-50355-13). Dep. NTIS.

Information concerning chemical, radioactive, and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. (D.C.C.)

25938 (DOCKET-50358-13) WM. H. ZIMMER NUCLEAR POWER STATION, UNIT 1. Preliminary Safety Analysis Report, Amendment 6. (Cincinnati Gas and Electric Co., Ohio. Columbus and Southern Ohio Electric Co., Columbus, Ohio. Dayton Power and Light Co., Ohio). 30 Mar 1971. 228p. Dep. NTIS.

Revised and additional information concerning control systems and instrumentation is presented. (D.C.C.)

25939 (DOCKET-50363-14) FORKED RIVER NUCLEAR GENERATING STATION, UNIT 1. Preliminary Safety Analysis Report, Amendment 9. (Jersey Central Power and Light Co., Morristown, N. J.). 1 Apr 1971. 171p. Dep. NTIS.

Revised design parameters of the Forked River Power Reactor Unit 1 are presented. Included also are additional data on the reactor requested by the Division of Reactor Licensing. (D.C.C.)

25940 (DOCKET-50387-1) SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2. License Application. (Pennsylvania Power and Light Co., Allentown). 1 Apr 1971. 35p. (DOCKET-50388-1). Dep. NTIS.

Application for construction permit and operating license for Susquehanna Power Reactor Units 1 and 2 is presented. The 1970 Annual Report for the Pennsylvania Power and Light Company is included. (D.C.C.)

25941 (DOCKET-50387-2) SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Vol. 1. (Pennsylvania Power and Light Co., Allentown). 1 Apr 1971. 379p. (DOCKET-50388-2). Dep. NTIS.

Information on Susquehanna Power Reactor Units 1 and 2 is presented under the broad topics of introduction and summary and site. (D.C.C.)

25942 (DOCKET-50387-3) SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Vol. 2. (Pennsylvania Power and Light Co., Allentown). 1 Apr 1971. 372p. (DOCKET-50388-3). Dep. NTIS.

Information on Susquehanna Power Reactor Units 1 and 2 is presented under the broad topics of reactor, and reactor coolant system. (D.C.C.)

25943 (DOCKET-50387-4) SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Vol. 3. (Pennsylvania Power and Light Co., Allentown). 1 Apr 1971. 404p. (DOCKET-50388-4). Dep. NTIS.

Information on Susquehanna Power Reactor Units 1 and 2 is presented under the following broad topics: containment; core standby cooling systems; and control and instrumentation. (D.C.C.)

25944 (DOCKET-50387-5) SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Vol. 4. (Pennsylvania Power and Light Co., Allentown). 1 Apr 1971. 307p. (DOCKET-50388-5). Dep. NTIS.

Information on Susquehanna Power Reactor Units 1 and 2 is presented under the broad topics of control and instrumentation and electrical power systems. (D.C.C.)

25945 (DOCKET-50387-6) SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Vol. 5. (Pennsylvania Power and Light Co., Allentown). 1 Apr 1971. 456p. (DOCKET-50388-6). Dep. NTIS.

Information on Susquehanna Power Reactor Units 1 and 2 is presented under the following broad topics: radioactive waste systems; auxiliary systems; power conversion systems; plant structures and shielding; conduct of operations; and plant safety analysis. (D.C.C.)

25946 (DOCKET-50387-7) SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Vol. 6. (Pennsylvania Power and Light Co., Allentown). 1 Apr 1971. 577p. (DOCKET-50388-7). Dep. NTIS.

Information on Susquehanna Power Reactor Units 1 and 2 is presented under the following broad topics: pressure boundary integrity criteria for piping, pressure vessels, and heat exchangers; proposed technical specifications; structural design and loading criteria; quality assurance program; conformance of AEC criteria; nuclear safety operational analysis; identification and resolution of AEC-ACRS concerns; inservice inspection program; interaction between Units 1 and 2; and site assembly of pressure vessel. (D.C.C.)

25947 (DOCKET-50387-8) SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2. Environmental Report, Construction Permit Stage. (Pennsylvania Power and Light Co., Allentown). 1 Apr 1971. 100p. (DOCKET-50388-8). Dep. NTIS.

Information concerning chemical, radioactive, and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. (D.C.C.)

25948 (ORNL-4645) SURVEY OF THERMAL RESEARCH PROGRAMS SPONSORED BY FEDERAL, STATE, AND PRIVATE AGENCIES (1970). Ulrikson, Gerald U.; Stockdale, Walter G. (Oak Ridge National Lab., Tenn.). Mar 1971. Contract W-7405-eng-26. 56p. Dep. NTIS.

A listing of projects in the U. S. concerned with the effects of nuclear power plant thermal effluents on the environment is presented. The projects are listed under the following categories: productive uses; bio-effects; limnological effects; combination and general; cycling towers; modeling; ecological surveys; physical and temperature surveys; and general surveys. The title of the project, the location, the investigator, the sponsor, and the

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duration of the study are included for each project listed. 9 references. (D.C.C.)

25949 SAFETY AND RISK OF NUCLEAR POWER STATIONS. Alder, F. (Eidgenoessische Institut fuer Reaktorforschung, Wuerenlingen, Switzerland). Neue Tech., B; 12: 201-6(Dec 1970). (In German).

True technical progress means that risks must be minimized to a degree that does not endanger human populations. The concept of zero risk—or 100% safety—is an illusion. In 10 tables, probabilities of death or injury are compared between natural diseases, mishaps, traffic accidents, war, suicide, electric energy, fossil fuel power stations, natural catastrophes, and nuclear power plants. The odds per million of dying from natural diseases or from effects of nuclear power stations are 10,000 to less than 0.1. When somebody builds his new home 100 m higher than the old one, his radiation burden increases to a larger degree than that to which he would be exposed if he moved into the vicinity of a nuclear power station. (H.B.G.)

25950 ASEISMIC DESIGN IN THE TSURUGA NUCLEAR POWER PLANT. III. DESIGN OF REACTOR INTERNALS, EQUIPMENT, AND PIPING. Akino, Kinji; Kato, Muneaki; Tamura, Seiya (Japan Atomic Power Co., Tokyo). Nippon Genshiryoku Gakkaishi; 13: 139-46(Mar 1971). (In Japanese).

The design of reactor internals, equipment, and piping is described. In respect of piping, a summary of vibration tests is also given. (auth)

25951 NUCLEAR SAFETY CRITERIA FOR THE DESIGN OF STATIONARY PRESSURIZED WATER REACTOR PLANTS. ANSI N 18.2 D 1970. Hinsdale, Ill.; American Nuclear Society (1970). 128p. Available from American Nuclear Society, Hinsdale, Ill.

Criteria intended for use in the design of the nuclear safety aspects of pressurized water reactor (PWR) power plants are presented. The criteria are intended to amplify the U.S.AEC general design criteria for nuclear power plants, and deal principally with functional requirements of PWR structures, components, and systems. (H.D.R.)

25952 AMERICAN STANDARD: SAFETY STANDARD FOR DESIGN, FABRICATION, AND MAINTENANCE OF STEEL CONTAINMENT STRUCTURES FOR STATIONARY NUCLEAR POWER REACTORS. ANSI N 6.2 1965. New York; American Society of Mechanical Engineers (1965). 9p. Available from American National Standards Inst., New York.

Criteria are presented for the design, construction, testing, and maintenance of welded steel pressure containment shells for power reactors. Normal pressure vessel requirements and special requirements imposed by service, structural conditions, and loadings are examined. (H.D.R.)

25953 INSURANCE OF NUCLEAR POWER PLANTS? Braun, H. (Allianz-Versicherungs AG., Munich). Atomwirt., Atomtech.; 16: 122-4(Mar 1971). (In German).

After a discussion of risks associated with construction and operation of nuclear power plants, various possibilities of compensating these risks through the formation of monetary reserves or insurance are outlined. Comparison of advantages and disadvantages between available procedures leads to the conclusion that insurance represents the most favorable approach. This conclusion is significantly determined by the insurers technical service that is especially important with respect to assembly and operation of machinery. 7 references. (tr-auth)

25954 MONITORING AND INSURING OF NUCLEAR POWER PLANTS. Koenig, H. (Nordwestdeutsche Kraftwerke AG, Hamburg). Atomwirt., Atomtech.; 16: 151-2(Mar 1971). (In German).

The Alliance Insurance Company periodically conducts technical seminars dealing with problems of nuclear power plants. Summarized are lectures and discussions of the 5th seminar held in Munich in December 1970. In addition to legal aspects of insurance, various technical problems were analyzed, such as operational experience at the power plant Lingen, significantly improved monitoring possibilities with new test methods for reactor pressure vessels, and equipment for testing available at the technical center of the Alliance Insurance Company. (H.B.G.)

25955 CONSIDERATIONS IN DESIGNING EARTHQUAKE-PROOF NUCLEAR POWER PLANTS. Santamaria Calderon, J. L. (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 14: 5-17(Jan-Feb 1970). (In Spanish).

The reasons that necessitate a seismological and seismotectonic study of the sites of nuclear power plants are studied. The damage that the earthquake can cause to the individual systems of a nuclear power plant are reviewed in order to obtain a classification to take into consideration in its anti-earthquake use. A summary is made of the knowledge about earthquakes: seismic scales, seismic waves, methods of evaluation in order to establish the bases for the seismological study of the siting. The Spanish standards for seismoresistant constructions are reviewed. (tr-auth)

Steam and Power Conversion Systems

25956 STEAM GENERATORS OF FORT ST. VRAIN NUCLEAR POWER PLANT, USA. Kaelin, W. Sulzer Tech. Rev.; 52: 167-74(1970).

Design parameters of the Fort St. Vrain Power Reactor steam generators are listed. Fabrication and testing procedures are described. (D.C.C.)

Power Reactor Development

Refer also to abstract 25148.

25957 (ANL-7783) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, FEBRUARY 1971. (Argonne National Lab., Ill.). 22 Mar 1971. Contract W-31-109-eng-38. 113p. Dep. NTIS.

Highlights of project activities for February 1971 are summarized. LMFBR physics development and component development are reviewed. Operations and analysis of ZPR-3, ZPR-6, ZPR-9, and ZPPR are described. The EBR-2 research and development projects are summarized. Reactor fuels and materials development, engineering development, fuel cycle chemistry, and LMFBR safety studies are reported. (D.C.C.)

25958 (GA-10444) PUBLIC SERVICE COMPANY OF COLORADO 330-MW(E) HIGH-TEMPERATURE GAS-COOLED REACTOR RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report for the Period Ending December 31, 1970. (Gulf General Atomic Co., San Diego, Calif.). 31 Jan 1971. Contract AT(04-3)-633. 110p. Dep. NTIS.

FORT ST. VRAIN POWER REACTOR, UNIT—remote viewing equipment for, temperature testing of television
—thermal insulation for, performance of
—fuel cycle management program for, development of
—core physics for
—fuel elements for, design and testing of
—core for, properties and irradiation stability of graphite in
—fuel element for, properties and irradiation stability of graphite in
—fuels for, irradiation testing of coated particle
—loading machine for, development of
GRAPHITE—radiation effects on, fast neutron
NEUTRONS, FAST—effects on coated particle fuels
—effects on properties of graphite
REACTOR FUELS—radiation effects on coated particle, fast neutron
REACTOR LOADING MACHINES—development of gas cooled reactor
TELEVISION EQUIPMENT—development for in-vessel viewing of gas cooled reactor
THERMAL INSULATION—development of gas cooled reactor pressure vessel
THORIUM CARBIDES—ThC_2–UC_2, irradiation testing of coated particles
URANIUM CARBIDES—ThC_2–UC_2, irradiation testing of coated particles (D.C.C.)

25959 (KFK-1270/3) FAST BREEDER PROJECT QUARTERLY REPORT, 1970. (Kernforschungszentrum, Karlsruhe (West Germany)). Nov 1970. 150p. (In German). (EUR-4571). Dep. NTIS (U. S. Sales Only).

The work done on fuel rod design, preparation and irradiation of fuel rods, reactor and rod material development and study, corrosion studies, coolant analyses, fuel cycles, reactor theory, safety of fast reactors, instrumentation and signal propagation for core monitoring, consequences of reactor incidents on the environment and activity release, sodium technology studies, thermodynamic and hydrodynamic research in gas and steam, reactor design studies, and the fast high flux test reactor FR 3 is reported in detail. (J.S.R.)

25960 (NP-18700) BIENNIAL MEMOIRS, 1968-1969. (Junta de Energia Nuclear, Madrid (Spain)). 1970. 190p. (In Spanish). Dep. NTIS (U. S. Sales Only).

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The work of the Junta de Energia Nuclear on the fuel cycle, nuclear reactors, desalination of water, isotopes, high energy physics, solid state physics, molecular biology, radiobiology, chemistry, and metallurgy for the years 1968 and 69 is briefly summarized. The lines of study followed are described and the experimental results are only indicated. (J.S.R.)

25961 FAST BREEDER REACTORS. Vendryes, G. (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). pp 214-29 of Proceedings of the Seminar on Nuclear Power. /Rastogi, B. P. (ed.). Bombay; Department of Atomic Energy (1970). (CONF-700113-10).

From Seminar on Nuclear Power, Bombay, India.

The principal features of the fast breeder reactors built in France and the problems encountered during their development are described. All fast breeder reactors in France up-to-date are sodium-cooled. The use of mixed UO_2-PuO_2 as fuel is preferred. The low fuel cycle cost attainable with fast breeder reactors is shown for the case of a 600 MW(e) FBR power plant. Research and development programs are described with emphasis on improving fuel assemblies, fuel cycles, mixed fuels (UO_2-PuO_2) and sodium technology. Reference is also made to the development in fast reactors in the USA, the USSR, Germany, Italy and Japan. (INIS)

25962 USA STANDARD: NUCLEAR REACTOR CLASSIFICATION SYSTEM. ANSI N 10.1 1968. Hinsdale, Ill.; American Nuclear Society (1969). 4p. Available from American National Standards Inst., New York.

Nuclear reactors are classified into three primary categories in an effort to standardize reactor nomenclature. The three categories are purpose, thermomechanical design, and nuclear design. Major classes within each category are listed, and identifying reactor names associated with each class are presented. (H.D.R.)

25963 REACTOR DEVELOPMENT PROSPECTS. Schulten, R. (Technische Hochschule, Aachen. Kernforschungsanlage, Juelich, Ger.); Bonka, H. Phys. Unserer Zeit.; 1: No. 2, 34-42(1970). (In German).

The competitive types of power reactors are discussed. Important types of reactors include heavy water moderated, graphite moderated, and light water moderated reactors as well as fast breeders. (INIS)

25964 FAST BREEDER REACTORS IN FRANCE. Com. Naz. Energ. Nucl., Notiz.; 16: No. 10, 114-18(Oct 1970). (In Italian).

The development of the fast reactor program is described. Key elements are the Rapsodie reactor, in operation since 1967, and the Phenix reactor, at present under construction. (auth)

Kinetics and Dynamics

Refer also to abstract 26068.

25965 (GEAP-13551) EFFECTS OF NUCLEAR METHODS APPROXIMATIONS ON LMFBR ANALYSIS. Protsik, R.; Crick, S. C.; Hersum, T. G.; Leff, E. G. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Development Operation). Aug 1969. Contract AT(04-3)-189. 25p. Dep. NTIS.

Numerical calculations of the effects of certain nuclear-methods approximations on LMFBR analysis are presented and discussed. The topics covered include: transport theory versus diffusion theory approximations; anisotropic scattering and the transport approximation; errors due to the subdivision of space, angle, and energy variables into discrete intervals; and heterogeneity effects of control rods. (8 references) (auth)

25966 (JUL-690-RG) REPORT ON THE PROBLEMS OF NEUTRON PULSE EXPERIMENTS ON COMPACT GRAPHITE AS WELL AS ON THE QUESTION OF HETEROGENEITY INFLUENCES OF CAVITIES ON THE DIFFUSION BEHAVIOR OF THERMAL NEUTRONS IN SYSTEMS WHICH CONTAIN SPHERICAL GRAPHITE ELEMENTS. Huels, Manfred (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung). Aug 1970. 220p. (In German). Dep. NTIS (U. S. Sales Only).

In addition to the various experimental methods for the determination of the diffusion parameter of thermal neutrons, the first part of the study also presents a survey of the theoretical attempts to represent the interaction of neutrons with moderator nuclei. The second and third parts contain the description and interpretation of neutron pulse experiments on compact graphite piles or on systems containing graphite spheres. Originally the task of the present study consisted in finding a clarifying answer to the question of the heterogeneity influence on the neutron diffusion in graphite sphere packings. (tr-auth)

25967 (RISO-235) DEVELOPMENT AND VERIFICATION OF NUCLEAR CALCULATION METHODS FOR LIGHT-WATER REACTORS. Jensen, K. E. Lindstroem (Danish Atomic Energy Commission, Risoe. Research Establishment). Dec 1970. 161p. Dep. NTIS (U. S. Sales Only).

The calculation methods for kinetics of light-water reactors developed in the TWODIM SYSTEM of programmes are described. Several methods for unit cell, assembly and over-all reactor burn-up investigations are available. The true irradiation history may thus be followed with respect to local flux spectrum and power changes where the leakage influence from the surrounding lattice on the local unit cell calculation is accounted for. A new accurate method is introduced for the control rod treatment. The applicability of the various computation methods is verified by means of a great number of detailed calculations that are compared with available measurements. 50 references. (auth)

25968 COMPARISON BETWEEN MODAL AND DIFFERENCE METHOD TO THE ANALYSIS OF THE NEUTRON FLUX DISTRIBUTION. Takahashi, Ryoichi; Hoizumi, Atsushi; Shindo, Masuo (Tokyo Inst. of Tech.). Bull. Tokyo Inst. Technol. (Engl. Ed.); No. 90, 39-50(Mar 1969).

A detailed design study is performed considering the two-dimensional neutron flux distribution for FBR. The two-dimensional flux distribution is given as a solution of a group of two-dimensional diffusion equations. The numerical difference method is almost always adopted for the calculation. But the solution can be obtained with the double series expansion method, too. The two methods were compared by means of numerical calculation. The results are shown and comparisons made. The numerical difference method is more convenient in so far as the more refined calculation of the determinant and solving the linear equations are not readily usable in the modal method. (Japan)

25969 UNIFORM DISTRIBUTIONS OF THERMAL NEUTRON FLUX OF NUCLEAR CHAIN REACTORS. Saito, Katumi (Nihon Univ., Chiba, Japan). Nihon Daigaku Seisan Kogakubu Hokoku; 3: No. 1, 63-7(Feb 1970). (In Japanese).

With a heterogeneous reactor, the power output can be increased by adjusting the flux in such a manner that the operating temperature of each fuel element is the same. In thermal reactor, the optimum situation of uniform temperature can often be approximated by requiring that the thermal flux be flat. The production of flat thermal flux by the nonuniform distribution of moderator is discussed within the framework of two group theory for two region reactors. Equations determining the moderator distribution are derived for two typical reactor systems. (auth) (Japan)

Control Systems

25970 HYDRAULIC FALL-BRAKE OR SHOCK ABSORBER FOR NUCLEAR REACTOR CONTROL RODS. Bezold, Helmut; Steinkamp, Eckhard (to Siemens Aktiengesellschaft). U. S. Patent 3,562,109. 9 Feb 1971. Priority date 14 Jan 1966, Germany.

Hydraulic shock absorber for a control rod in a nuclear reactor is formed of a vertically extending guide tube for receiving a falling control rod. The guide tube is cylindrical along the entire length and has longitudinally spaced cylindrical constrictions at the lower end. Openings are provided in the guide tube above the constrictions to permit reactor coolant fluid to pass through. (auth)

Cooling Systems

Refer also to abstract 23925.

25971 (ANL-7651) STUDY OF COOLANT TRANSIENTS DURING A RAPID FISSION-GAS RELEASE IN A FAST-REACTOR SUBASSEMBLY. Chawla, T. C.; Hoglund, B. M. (Argonne National Lab., Ill.). Jan 1971. Contract W-31-109-eng-38. 41p. Dep. NTIS.

Flow transients initiated by rapid gas release were studied both experimentally and analytically. The mathematical model developed was used to consider a multiple pin failure in a fast-reactor subassembly. In formulating the model, it was assumed that the released gas filled the subassembly cross section uniformly and that the coolant flow was incompressible. The inertial contribution of the liquid columns beyond the pin assembly, as well as the three-dimensional flow effects in the inlet and outlet

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plenums, were considered. In the application of the model to out-of-pile simulation loops or in-pile test loops, points of departure in hydraulic simulation of the actual reactor conditions can be taken into account. A quantitative criterion for valid application of the model was obtained in terms of breach size, number of pins ruptured, initial gas-plenum pressure and temperature, and subassembly operating conditions. The predictions of the flow transients obtained by means of the model agreed well with the experimental data. An example of the application of the model to a reactor configuration was given using an FFTF fuel subassembly. (15 references) (auth)

25972 (BNWL-SA-3807) CORROSION AND ITS EFFECTS IN NUCLEAR POWER PLANT SYSTEMS. Demmitt, Thomas F. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). [1971]. Contract AT(45-1)-1830. 23p. (CONF-710504-1). Dep. NTIS.

From 5. annual western states corrosion seminar; San Dimas, Calif. (5 May 1971).

Corrosion processes and their effects in the primary cooling systems of boiling water reactor and pressurized water reactor power plants are discussed. The major components of the cooling systems, operating conditions, materials of construction, and consequences of the various forms of corrosion are described. (H.D.R.)

25973 (IAE-1968) METHOD OF CALCULATING FISSION ACTIVITY OF WATER IN THE PRIMARY LOOP OF A WATER-WATER POWER REACTOR. Luzanova, L. M.; Pologikh, B. G. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Atomnoi Energii). 1970. 22p. (In Russian). Dep. NTIS (U. S. Sales Only).

One version is presented of a system describing the output of fission products from sintered UO_2 to water during operation of a reactor with non-sealed fuel element envelopes. The system is based on description of the transfer of fission products within the fuel elements and from the fuel elements to the water using two constant coefficients characterizing the rates of movement of volatile and gaseous elements. The calculated rates of leakage of fission products into the water based on these two coefficients are compared with values of leakage rates determined experimentally. The system suggested is illustrated by calculating the composition of activity of water in the first loop of a nuclear power plant with a water-water reactor with certain assumptions concerning the magnitude of leaks in the unsealed fuel elements. 3 references. (JPRS)

25974 (ORNL-TM-2815) COMPUTER PROGRAMS FOR MSBR HEAT EXCHANGERS. Bettis, C. E.; Crowley, W. K.; Nelms, H. A.; Pickel, T. W.; Siman-Tov, M.; Stoddart, W. C. (Oak Ridge National Lab., Tenn.). Apr 1971. Contract W-7405-eng-26. 158p. Dep. NTIS.

Three computer programs were developed to make design calculations for the heat exchangers for Molten-Salt Breeder Reactor concepts. They are the program for the primary heat exchangers, PRIMEX; the program for the reheaters, RETEX; and the program for the steam generator superheaters, SUPEX. Each type of exchanger analyzed is described, the basic equations used in each analysis are given, and the logic used in each program is discussed briefly in this report. Flow diagrams, lists of input required and output received, complete program listings, and the nomenclature for the programs as well as example computer input and output for the exchangers described are appended. 22 references. (auth)

25975 TEMPERATURE AND CONCRETE. 21st ACI Fall Meeting, Memphis, Tenn., November 1968. ACI Special Publication SP 25. Detroit; American Concrete Institute (1971). 319p. (CONF-681109).

Included are 13 papers on the effects of normal and high temperatures on concrete structures. A separate abstract was prepared for one paper on the effects of temperature on prestressed concrete reactor vessels. (H.D.R.)

For an abstract of an individual paper see: 25976.

25976 EFFECTS OF TEMPERATURE ON A PRESTRESSED CONCRETE REACTOR VESSEL MODEL. Northup, T. E.; Ople, F. S. Jr. pp 149-71 of Temperature and Concrete. Detroit: American Concrete Inst. (1971).

From Symposium on the Effect of Temperature on Concrete, Memphis, Tenn. See CONF-681109.

Results of elevated temperature tests on a one-quarter scale prestressed concrete reactor vessel (PCRV) model are reported. The long-term behavior of the PCRV model was evaluated for sustained temperatures up to 140°F (60°C). Major emphasis was placed on the creep of concrete subjected to complex mechanical and thermal loading conditions. The effect of elevated temperature on the creep (including shrinkage) of concrete in a PCRV model was observed to be less severe than the effect that normally would be observed in tests on small plain concrete specimens. Approximations utilizing uniaxial creep data can lead to substantial overestimation of concrete creep deformations in a complex structure, especially at elevated temperatures. The approach using viscoelastic finite-element analysis along with similar uniaxial creep data is shown to produce better prediction of concrete creep behavior in a PCRV model. (auth)

25977 BOILING HEAVY WATER INDIRECT-CYCLE REACTOR. Fajeau, M. (to Commissariat a l'Energie Atomique). Canadian Patent 858,748. 15 Dec 1970. Priority date 24 Apr 1967, France.

The reactor is an integrated heat exchanger type, including a pressure vessel, a heavy-water moderator tank traversed by vertical pressure tubes which contain fuel elements and open at the top ends thereof into a collector space located above the tank. There are deflector means which delimit, starting from the collector space, a first heavy-water circuit comprising successively the heat exchangers, the interior of the tank and a first part of the pressure tubes also a second heavy-water circuit constituted by a duct which bypasses the heat exchangers and the other part of the pressure tubes. (F.S.A.)

25978 MEASUREMENTS OF SODIUM LEVEL IN PFR. McGonigal, G.; Dean, S. A.; Ferguson, B. G.; Harrison, E. (United Kingdom Atomic Energy Authority, Risley, Eng.). Nucl. Eng. Int.; 16: 62-4(Jan-Feb 1971).

Electromagnetic level sensors of the mutual inductance type were developed for control of the numerous free liquid-sodium surfaces of the coolant circuits of the Prototype Fast Reactor. Three forms of sensor, using mineral insulated stainless steel sheathed Nichrome conductor cables as winding, are described. These are used for analogue level measurements for process control, level trip, and dipstick measurements for portable use during reactor filling and on storage facilities. The effects of temperature and operating frequency on the sensors are discussed. It is shown how stringent requirements, in terms of high amplitudes and frequency stability for the electronic equipment, are met for each type of circuit arrangement. (UK)

25979 ENGINEERING EXPERIMENTS ON FUEL ELEMENTS FOR THERMAL WATER REACTORS. Bianchi, G.; Cumo, M.; Evangelisti, R.; (and others) (CNEN, Casaccia, Italy). Com. Naz. Energ. Nucl., Notiz.; 17: No. 2, 39-58(Feb 1971). (In Italian).

A series of engineering experiments on BWR fuel elements are reported. The research centered on the thermo-mechanical dimensioning of new fuel elements and a series of supporting tests, including measurements of the vibratory performance of the elements, a parametric investigation of fretting corrosion, as well as hydraulic and thermodynamic experiments. 19 references. (auth)

25980 IMPROVEMENTS RELATING TO ROTARY ELASTIC FLUID OR HYDRAULIC MACHINE INSTALLATIONS. Walters, Kenneth; Rodwell, Christopher (to English Electric Co. Ltd.). British Patent 1,223,997. 3 Mar 1971. Filed 11 Dec 1967.

Reference is made to installations which include machines such as blowers, fans, compressors, pumps, turbine, etc. such as are described in BP 1,017,961 (Jan. 18th 1963), and various improvements are claimed. One such improvement is the provision of adjustable guide vanes and an actuating member that is movable between a first position in which it engages means for adjusting the guide vanes and a second position in which it engages means for operating port closing means. Various designs of actuating members and port closing means are described. Applications described include motor blower units for gas-cooled nuclear reactors. (UK)

25981 LIQUID-METAL COOLED NUCLEAR REACTORS. Lee, Alan Stuart (to English Electric Co. Ltd.). British Patent 1,224,320. 10 Mar 1971. Filed 5 Dec 1967.

It is stated that in liquid metal cooled reactors having pump assemblies projecting downwards to one side of the reactor core, or heating means extending across a space between the roof of the vessel containing the heating means and the surface of the pool of liquid metal, difficulties may arise due to thermal distortion resulting from uneven heating of the external surfaces of the pump assembly in the blanket gas above the pool surface. The object of the system described is to prevent or minimize such distortion. The outlet duct from the pump communicates with the pump as-

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sembly immediately below the roof of the containing vessel, and upward guiding means are provided for the liquid metal drawn from the pool, from the level of the pool surface to the outlet duct; by this means substantially all that part of the pump assembly within the vessel is subjected from within to the temperature of the liquid metal drawn from the pool and delivered to the outlet duct. Various elaborations of the system are described. (UK)

25982 REACTOR STEAM CIRCULATOR. Hines, Douglas P. (to General Electric Co.). U. S. Patent 3,565,761. 23 Feb 1971. Filed 29 Jan 1968.

A steam circulating system for a steam cooled nuclear reactor is disclosed. This system includes a steam thermopresser for driving saturated steam coolant through the reactor core and associated piping. (auth)

Fuels

25983 (GEAP-13620) FAILED FUEL PERFORMANCE IN NATURALLY CONVECTING LIQUID METAL COOLANT. Gregoire, K. E.; Novak, P. E.; Murata, R. E. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Development Operation). Jun 1970. Contract AT(04-3)-189. 46p. Dep. NTIS.

The results of an experiment are described in which two fuel specimens containing mixed oxide ($Pu_{0.25}U_{0.75})O_{2.0}$ were irradiated in NaK cooled natural circulation capsules in the GETR at power and temperature conditions in excess of those expected in current LMFBR designs. Both of the specimens failed at ≤18,000 MWd/Te. One of the specimens was immediately removed from the reactor after failure while the other was permitted to continue irradiation to 53,000 MWd/Te. Observation of both failed fuel pins showed significant transverse dimensional changes and fuel-cladding reaction. (11 references) (auth)

25984 (JUL-707-RW) APPARATUS FOR MEASUREMENT OF THE RELEASE OF FISSION GASES AND OTHER FISSION PRODUCTS BY HEATING. Stradal, Karl Alfred (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorwerkstoffe). Oct 1970. 64p. (In German). Dep. NTIS (U. S. Sales Only).

In gas-cooled high temperature reactors, the fuel is generally in the form of small particles which are coated, for example, with pyrolytic carbon. The coating has the task of keeping the fission products from the coolant gas. Within the framework of the development of these layered particles, the coating integrity must be tested. In addition to other possibilities the heating test after irradiation in the reactor can be used. An apparatus is described which was developed and introduced to determine with very high sensitivity the release of fission gases and non-volatile fission products. 10 references. (tr-auth)

25985 (RD/B/N-1887) RADIATIONS FROM CAGR FUEL: α-ACTIVITY, β-HEATING, γ-SPECTRA, AND NEUTRON EMISSION. Beynon, S. M.; Clarke, R. H. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Jan 1971. 26p. Dep. NTIS (U. S. Sales Only).

Calculations were performed to obtain the heavy element content and fission product inventory in typical CAGR fuel. The α-activity and β-heating were calculated as a function of cooling time after irradiation. The γ-spectrum from the fuel was determined for the two basic γ-spectra available that cover all the nuclides within the fuel and the results are compared. The neutron production rates within the fuel from both spontaneous fission and (α,n) reactions on oxygen were also estimated. 10 references. (auth) (UK)

25986 (RT/FI-(70)48) RECYCLE OF PLUTONIUM: PHYSICS EXPERIMENTS CARRIED OUT IN THE CASACCIA REACTOR. Orestano, F.; Pistella, F. (Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Centro di Studi Nucleari). [1970]. 43p. (In Italian). Dep. NTIS (U. S. Sales Only).

The studies performed in the reactors at CSN Casaccia for the program of experiments with a plutonium lattice are described. These experiments are to establish the plutonium recycle in water reactors. 42 references. (auth)

25987 (WCAP-3385-26) SAXTON PLUTONIUM PROJECT. Quarterly Progress Report for the Period Ending December 31, 1970. Caye, T. E.; Smalley, W. R. (Westinghouse Electric Corp., Pittsburgh, Pa. Nuclear Fuel Div.). Mar 1970. Contract AT(30-1)-3385. 20p. Dep. NTIS.

PLUTONIUM—utilization in pressurized water reactor fuels, (E/T)

PLUTONIUM OXIDES PuO_2—PuO_2–UO_2, radiation effects on burnup, microstructure, and dimensions of fuels of, in-pile, (E)

REACTOR FUEL ELEMENTS—performance of Zircaloy clad mixed oxide, in pressurized water reactors, (E/T)

REACTORS, PRESSURIZED WATER—fuels for, utilization of plutonium in, (E/T)

—fuel elements for, performance of Zircaloy clad mixed oxide, (E/T)

SAXTON POWER REACTOR—fuel elements for, in-pile performance of Zircaloy clad plutonium oxide (PuO_2)–uranium oxide (UO_2), (E/T)

—operation during October through December 1970

URANIUM OXIDES UO_2—PuO_2–UO_2, radiation effects on burnup, microstructure, and dimensions of fuels of, in-pile, (E)

ZIRCALOY-4—corrosion film formation on pressurized water reactor fuel element cladding of, (E)

25988 FUEL CYCLES IN HEAVY WATER REACTORS. Meckoni, V. N.; Rastogi, B. P. (Bhabha Atomic Research Centre, Bombay). pp 245-59 of Proceedings of the Seminar on Nuclear Power. /Rastogi, B. P. (ed.). Bombay; Department of Atomic Energy (1970). (CONF-700113-3).

From Seminar on Nuclear Power, Bombay, India.

Some results of fuel cycle studies carried out in the case of heavy water reactors are presented. Various aspects, such as natural uranium cycle, plutonium recycle and utilization of thorium, are discussed. The low fuel cycle cost of heavy water reactors, the flexibility for various fuel cycle schemes and its competitiveness even with the fast breeders has made it a very important concept for the present as well as for the future. It is pointed out that heavy water reactors would play a signicant role in the nuclear contribution to the total energy requirements of India. (INIS)

25989 PRESSURE DROP PERFORMANCE OF FUEL PIN BUNDLE WITH SPIRAL WIRE SPACER. Wakasugi, Kazuhiko; Kakehi, Isao (Tokyo Shibaura Electric Co,. Ltd., Kawasaki, Japan). J. Nucl. Sci. Technol. (Tokyo); 8: 167-72(Mar 1971).

The pressure drop characteristics of a JEFR type fuel pin bundle were obtained from hydraulic tests. The coefficient of drag attributable to the spiral wire spacer wound round each fuel pin, as defined by de Stordeur, was found to be approximately 0.30 for the hexagonal lattice arrangement adopted. The coefficient is independent of spiral wire pitch, which ranged from 90 to 260 mm. The pressure drop to be expected in a fuel pin bundle with spiral wire spacer, such as used in current fast breeder applications, can be satisfactorily estimated by using the coefficients reported. 18 references. (auth)

25990 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENT ASSEMBLIES FOR NUCLEAR REACTORS. Mantle, Paul Langford (to Central Electricity Generating Board). British Patent 1,224,465. 10 Mar 1971. Filed 17 May 1967.

Reference is made to cluster type fuel elements. In the type employed in the AGR one of the problems which arise is that one side of the cluster experiences higher flux than other parts, due to unavoidable discontinuities in the reactor core, resulting in non-uniform heat distribution. The fuel element temperature might be as much as 40°C higher on one side of a cluster, and the reactor power output is restricted as compared with what would be possible with a more uniform temperature distribution. The fuel element assembly described is claimed to give a more uniform temperature distribution. The assembly comprises a cluster of ribbed fuel pins arranged parallel to one another, the ribs of adjacent pins being spaced apart to permit flow of coolant in a generally axial direction; some of the pins are provided with helical ribs, some with a left-handed helix and others right-handed, to impart transverse components to the longitudinal flow. The ribs may be formed integrally with the can, or may be formed by wrapping wire around the can. Various alternative arrangements are described. (UK)

Auxiliary and Emergency Systems

25991 SPRAY PROGRAM AT THE NUCLEAR SAFETY PILOT PLANT. Parsly, L. F. (Oak Ridge National Lab., Tenn.). Nucl. Technol.; 10: 472-85(Apr 1971). (CONF-700608-31).

From American Nuclear Society meeting; Los Angeles, Calif. (29 Jun 1970).

The spray program conducted at the Nuclear Safety Pilot Plant in 1967–1970 is summarized. Sprays have been proposed as a means for removing fission products from reactor containment building atmospheres following a loss-of-coolant acci-

dent. The problem was dealt with in three parts: removal of elemental iodine, removal of organic iodides, and removal of particles. Twenty-eight iodine removal experiments were performed using borax, borax plus thiosulfate, and boric acid. Both borax and borax-thiosulfate were highly effective in removing elemental iodine. Boric acid is much more effective than expected. Fifteen methyl iodide removal experiments were performed. Only borax-thiosulfate at elevated temperatures removed methyl iodide at a significant rate. Extrapolation of the data to a large PWR indicates the dose reduction factor would be 1.1 for the flow, drop size, and reagent concentration normally specified. This can be improved by increasing flow and/or concentration or by reducing drop size. Fifteen particle removal experiments were done. These show that phenomena associated with steam condensation make the major contribution to removing particles. The results indicate that sprays will remove particles effectively. 14 references. (auth)

25992 REMOVAL OF IODINE FROM ATMOSPHERE BY SPRAYS. Nishizawa, Y.; Oshima, S.; Maekawa, T. (Mitsubishi Atomic Power Industry, Inc., Omiya, Japan). Nucl. Technol.; 10: 486-98(Apr 1971). (CONF-700608-30).

From American Nuclear Society meeting; Los Angeles, Calif. (29 Jun 1970).

The objective of the study was to demonstrate the efficiency of the containment spray system on the removal of iodine from atmosphere under environmental conditions expected in a reactor accident. As a small-scale vessel simulating a reactor containment, two types of steel vessels were used: one was made of mild steel with the interior surface painted, the other was made of stainless steel. Both tanks were 1.5-m dia × 3 m high. The removal rates of iodine with and without sprays were measured as functions of spray system conditions such as temperature, pressure, spray flow rate, and spray solution. The removal rates were evaluated from the variation for iodine concentration in the gas phase, which was determined by means of the thiosulfate titration method for elemental iodine and gas-liquid chromatographic techniques for organic iodides. 10 references. (auth)

25993 SODIUM THIOSULFATE SPRAY SYSTEM FOR RADIOIODINE REMOVAL. Joyce, W. E. (Babcock and Wilcox, Lynchburg, Va.). Nucl. Technol.; 10: 444-8(Apr 1971). (CONF-700608-28).

From American Nuclear Society meeting; Los Angeles, Calif. (29 Jun 1970).

Radioiodine constitutes the greater radiological hazard to the public in the event of a loss-of-coolant accident (LOCA). There are presently two ways to remove iodine from the containment atmosphere: filter-absorber systems and containment spray system. The advantages of the spray system are (a) the removal for radioiodine is faster resulting in lower thyroid site doses, (b) an existing system could be modified, and (c) the cost of the system is less. (auth)

25994 RADIATION AND THERMAL STABILITY OF SPRAY SOLUTIONS. Zittel, H. E.; Row, T. H. (Oak Ridge National Lab., Tenn.). Nucl. Technol.; 10: 436-43(Apr 1971). (CONF-700608-34).

From American Nuclear Society meeting; Los Angeles, Calif. (29 Jun 1970).

Studies are described for a series of pressure suppression and fission product removal sprays to ascertain their stability under coolant loss conditions in pressurized-water reactors. It was found that several of the solutions exhibit satisfactory behavior under accident conditions while others were discarded from consideration because of either thermal and/or radiation instability. The two sprays found to demonstrate acceptable stabilities under test conditions are the basic borate (0.15N NaOH-3000 ppm B) and basic borate thiosulfate (1 wt/% $Na_2S_2O_3$ – 0.15N NaOH-3000 ppm B). However even these demonstrate a radiolytic gas generation (H_2) sufficient to be a possible safety hazard. Various studies have been carried out to establish $G(H_2)$ values and/or equilibrium radiolytic gas concentrations. Other studies were carried out on possible spray solution interaction with reactor containment metals and alloys. 3 references. (auth)

25995 REMOVAL OF IODINE AND PARTICLES BY SPRAYS IN THE CONTAINMENT SYSTEMS EXPERIMENT. Hilliard, R. K.; Postma, A. K.; McCormack, J. D.; Coleman, L. F. (Battelle-Northwest, Richland, Wash.). Nucl. Technol.; 10: 499-519 (Apr 1971). (CONF-700608-27).

From American Nuclear Society meeting; Los Angeles, Calif. (29 Jun 1970).

Eight large-scale spray experiments have been made in the 26,500 ft^3 Containment Systems Experiment (CSE) vessel. In each experiment a major parameter was changed. Spray fluxes ranged from 0.025 to 0.3 gal/(min ft^2). Spray drop size was 770 or 1210 μm mass median diameter (MMD). Atmospheric condition was air at room temperature and pressure or steam-air initially at 250°F, 48 psia. Three types of spray solutions were used: boric acid, pH 5; boric acid plus NaOH, pH 9.5; and boric acid plus 1 wt % $Na_2S_2O_3$ with NaOH added to pH 9.5. The only major parameters not varied were the drop fall height (38 ft) and the gas-to-volume ratio (~80). 17 references. (auth)

25996 STABILITY OF THIOSULFATE SPRAY SOLUTIONS. Bishop, W. N. (Babcock and Wilcox, Lynchburg, Va.). Nucl. Technol.; 10: 449-53(Apr 1971). (CONF-700608-24).

From American Nuclear Society meeting; Los Angeles, Calif. (29 Jun 1970).

Although chemical sprays are effective for removing radioactive iodine, the suitability of a particular chemical solution for use in the reactor building spray system depends upon the solution's stability and compatibility in the environment produced by LOCA. The suitability of alkaline $Na_2S_2O_3$ for use in the reactor building spray system as an iodine-removal agent has been the subject of an extensive research and development program. The results of the program demonstrate the stability and compatibility of the $Na_2S_2O_3$ spray solution. 5 references. (auth)

25997 STUDIES ON IODINE TRAPPING BY WATER SYSTEMS AT STUDSVIK. Devell, L.; Hesboel, R.; Bachofner, E. (Aktiebolaget Atomenergi, Studsvik, Sweden). Nucl. Technol.; 10: 466-71(Apr 1971). (CONF-700608-25).

From American Nuclear Society meeting; Los Angeles, Calif. (29 Jun 1970).

From large-scale experiments on the iodine removal efficiency of a water pool at 100°C as well as from supporting laboratory runs within the concentration range 10^{-8} to 10^{-5} M, it was observed that permanent trapping was achieved to a great extent even at neutral pH conditions. The efficiency was considerably higher at lower iodine concentration. The fraction permanently trapped approximately corresponded to the theoretically evaluated equilibrium amounts of hypoiodous acid and iodide. A mathematical model designed for the washout of molecular iodine in reactor containment atmosphere by sprays gives iodine concentration in containment versus spray time. The model takes the degree of hydrolysis of iodine at different pH-values and concentrations into consideration. Initial results from spray experiments performed in a 2.5 m^3 tank at pH = 6 to 7.5 and gas phase concentrations around 4×10^{-4}, 5×10^{-5} and 1.5×10^{-6} kg m^3 gave half-times due to spraying of about 45, 5 and 2 minutes respectively. They confirm the expected strong influence of iodine concentration on washout half-time. (auth)

25998 FISSION-PRODUCT DETECTION SYSTEMS IN HIGH-TEMPERATURE GAS-COOLED REACTORS. Baumann, C. D. Nucl. Safety; 12: 90-9(1971).

An applications study is made of radiation-measuring instruments and systems that might be suitable for development as monitors of the fission-product activity of the primary-gas-coolant stream in high-temperature gas-cooled reactors. Particular attention is given to the plateout in loop components, primarily the heat exchangers. The detectors reviewed are ionization chambers, beta and gamma spectrometers, charged-wire precipitators, Cerenkov detectors, filters, diffusion tubes, thermal-gradient tubes, deposition tubes, and impactors. The principle of operation of each in a system is described, and the advantages and disadvantages in application to the problem are evaluated. On the basis of liner-penetration requirements, gas-stream-sampling techniques, concurrency of readout, and the characteristic merits of the individual systems, it appears that the deposition-tube and gamma-spectrometer systems can be further developed as competent plateout monitors for high-temperature gas loops in nuclear-reactor service. 36 references. (auth)

25999 STUDY OF THE ABSORPTION OF CH_3I BY AQUEOUS SPRAY SOLUTIONS. Soldano, B. A.; Ward, W. T. (Oak Ridge National Lab., Tenn.). Nucl. Technol.; 10: 460-5(Apr 1971). (CONF-700608-32).

From American Nuclear Society meeting; Los Angeles, Calif. (29 Jun 1970).

A kinetics study has been made of the chemical factors that affect the rate of absorption of CH_3I by aqueous sprays. The results suggest that the addition of certain transition metal complexes which promote singlet to triplet electronic transitions in CH_3I materially improve the latter's absorption rate by standard borated water droplets. (auth)

Operation and Economics

Refer also to abstracts 26052, 26053, and 26055.

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26000 CRITERIA FOR CHOICE OF SURFACE FORM FOR GAS COOLED REACTORS. Wilkie, D. (United Kingdom Atomic Energy Authority, Sellafield, Eng.). Nucl. Eng. Int.; 16: 215-17 (Mar 1971).

The criterion for comparing the surface form of fuel elements, which is for constant thermal performance, is discussed, and the criterion for constant pumping power is considered. Both criteria are extended to take account of parasitic pressure losses both within the channels and for the section of the circuit outside the fuel channel. The more complex criterion indicates a 5% performance improvement in an AGR. This is significant if it allows a reactor already built to reach its design performance, and could also be of value at the design stage. (UK)

Safety and Siting

Refer also to abstracts 23548, 23553, 25994, and 25996.

26001 (BNWL-1463) COOLANT BLOWDOWN STUDIES OF A REACTOR SIMULATOR VESSEL CONTAINING A PERFORATED SIEVE PLATE SEPARATOR. Allemann, R. T.; McElfresh, A. J.; Neuls, A. S.; Townsend, W. C.; Wilburn, N. P.; Witherspoon, M. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Feb 1971. Contract AT(45-1)-1830. 284p. Dep. NTIS.

Safety studies simulating pressurized water and boiling water reactor hypothetical piping breaks were conducted in a 150 ft^3 vessel. High pressure water blowdowns (up to 2100 psi, 600°F) were studied using orifice diameters of 0.9 to 5.2 in. at three different nozzle locations on the vessel. A sieve plate separator was used to divide the vessel into upper and lower volumes. Internal pressure and temperature, liquid level, thrust reaction forces, weight of fluid in the vessel, and movement of the sieve plate during the flow transient were measured during the blowdowns, and the data is presented. Anomalous depressurization behavior was shown to be the result of dissolved nitrogen and instrument configuration. A steam dome below the plate formed in some cases during downward flow of the fluid in the vessel. The forces on the plate inferred from the plate deflection were less than predicted. The nozzle length had little effect on the mass flux during blowdown. Comparisons were made with subcooled depressurization predictions for both the subcooled and saturated regimes. The predictions showed good agreement where realistic orifice pressure functions and orifice flow coefficients were used. 38 references. (auth)

26002 (BNWL-SA-3355) LARGE SCALE AIR CLEANING TESTS IN THE CONTAINMENT SYSTEMS EXPERIMENT. McCormack, J. D.; Hilliard, R. K. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). [1970]. Contract AT(45-1)-1830. 24p. Dep. NTIS.

Results of five CSE experiments in which an internal recirculating air-cleaning loop was run in steam-air atmospheres are presented. The loop was composed of a commercial sized heat exchanger, demister, filters and charcoal beds. Variables investigated were loop flow, atmospheric temperature, component arrangement and aerosol source term. The observed removal of iodine, cesium, uranium, and methyl iodide from the typical water cooled reactor post-accident atmosphere is compared to a model which assumes a well mixed gas space. (14 references) (auth)

26003 (HEDL-TME-71-23) COST-BENEFIT ALGORITHMS FOR EVALUATING HYDRO-ENVIRONMENTAL EFFECTS OF NUCLEAR POWER PLANTS. Fields, S. R. (Hanford Engineering Development Lab., Richland, Wash.). 26 Jan 1971. Contract AT(45-1)-2170. 83p. Dep. NTIS.

Cost-benefit algorithms have been developed to evaluate the hydro-environmental effects resulting from thermal discharges from nuclear and other thermal power plants. The two algorithms developed are the problem structure space volume algorithm (PSVA) and the problem structure graph theoretic algorithm (PGTA). The latter is recommended because it requires less effort on the part of decision-makers and yields a greater variety of results. A sample evaluation was made to illustrate the use of and to compare the results from each of the algorithms. The results of the sample evaluation indicate that the algorithms are effective tools for implementing a team approach to the selection and evaluation of methods of dissipating heat from thermal power plants, taking into account the relative importance of the identified hydroenvironmental effects and the characteristics of the receiving body of water. 6 references. (auth)

26004 (IRS-F-4) PROGRESS REPORT ON RESEARCH PLANS WHICH THE BUNDESMINISTERIUM FOR ENGINEERING AND SCIENCE HAS REQUIRED AND HAS SIGNIFICANCE UNDER THE VIEW OF REACTOR SAFETY. Rieger, W.; Tietze, A.; Wutschig, R. (Technischer Ueberwachungs-Verein e.V., Cologne (West Germany). Institut fuer Reaktorsicherheit). Sep 1970. 63p. (In German). Dep. NTIS (U. S. Sales Only).

The Institute for Reactor Safety reports government supported research in West Germany during the second half of 1969. The following projects are discussed: advanced instrumentation of nuclear reactors; development of a high-temperature-resistant steel for containment vessels; interaction between nuclear fuels and air, water, and steam; studies of sudden pressure drops in the containment vessel; absorption of gaseous fission products on molecular sieves; development of an aerosol particle counter with laser light; early detection of fatigue in reactor components; development of a new hydraulic fast cutoff system for reactors; criticality studies; and production of semiconductor probes for monitoring neutron flux in reactors. (H.B.G.)

26005 TOXICITY TO FISH OF TWO ORGANIC REACTOR COOLANTS. Guthrie, J. E.; Acres, O. E. (Whiteshell Nuclear Research Establishment, Pinawa, Manitoba). Bull. Environ. Contam. Toxicol.; 5: 145-51(Mar-Apr 1970). (AECL-3532).

The use of terphenyl compounds to cool nuclear reactors prompted an inquiry into the effect of these substances in the aquatic environment, should they be accidentally released. Santowax OM + 30% high boilers and HB-40 are two terphenyl compounds under study as nuclear reactor coolants at Whiteshell Nuclear Research Establishment. The acute toxicity of these two coolants to rainbow trout fry has been investigated, and it was found that Santowax OM was the more toxic. The behavior of fish exposed to suspensions of Santowax OM in water is briefly described. 15 references. (auth)

26006 PROTECTIVE COATINGS (PAINTS) FOR PWR AND BWR REACTOR CONTAINMENT FACILITIES. Watson, C. D.; Griess, J. C.; Row, T. H.; West, G. A. (Oak Ridge National Lab., Tenn.). Nucl. Technol.; 10: 538-45(Apr 1971). (CONF-700608-33).

From American Nuclear Society meeting; Los Angeles, Calif. (29 Jun 1970).

Protective coatings applied to the interior surfaces of containment facilities are expected to be resistant to an irradiation exposure of up to 10^9 rads, pressures of up to 60 psig, heated borated suppression solutions, and to remain in place during and following a design basis accident (DBA) occurring as late as the last day of 40 years of service. Many coating systems exposed to simulated DBA conditions in the laboratory and field evaluations survived the tests. The test data were used as a basis for writing a standard, "ANSI 101.2-1971 Protective Coatings (Paints) for Light Water Reactor Containment Facilities." 8 references. (auth)

26007 POST-ACCIDENT HYDROGEN GENERATION AND CONTROL. LaBelle, D. W. (Babcock and Wilcox, Lynchburg, Va.). Nucl. Technol.; 10: 454-9(Apr 1971). (CONF-700608-29).

From American Nuclear Society meeting; Los Angeles, Calif. (29 Jun 1970).

The hydrogen accumulation following a loss-of-coolant accident in a 2535 MW(t) pressurized water reactor plant is analyzed. The corrosion of Al and Zn components when contacted with an alkaline $Na_2S_2O_3$ spray solution is found to be a major source of post-accident hydrogen generation. The H_2 from metals corrosion, from radiolytic decomposition of the coolant, and from the Zircaloy-water reaction of the overheated fuel cladding can reach a flammable concentration (4.1% by volume) in the reactor building within 1 to 2 months. It is concluded that the most promising solution to the H_2 accumulation problem is controlled purging of the reactor building atmosphere to the outside environment. (H.D.R.)

26008 PROGRESS SUMMARY OF NUCLEAR SAFETY RESEARCH AND DEVELOPMENT PROJECTS. Savolainen, A. W.; Whetsel, H. B. (eds.). Nucl. Safety; 12: 148-59(1971).

Information concerning nuclear safety research and development projects up to November 1, 1970 is presented under the following broad topics: HSST program for water cooled reactors; environmental and effluent control studies; Nuclear Safety Information Center; fast reactor safety; and gas cooled reactor safety. (D.C.C.)

26009 DISPOSAL INTO THE HUMAN ENVIRONMENT OF RADIOACTIVE WASTE FROM ATOMIC REACTORS, WITH SPECIAL REFERENCE TO WATER SUPPLY. Ruf, Manfred (Bayerische Biologische Versuchsanstalt, Munich). Zentralbl. Veterinaermed., Beih.: No. 11, 167-80(1970). (In German).

From 2nd Symposium on Radioactivity and Radiation Biology and Their Significance for Veterinary Medicine, Hanover, Germany. See CONF-680672.

The radioactive waste products of working nuclear reactors are mainly gaseous and liquid. Special decontamination plants concentrate and store them in a way secure against radiation. Because of technical and economic reasons a small part of the radioactivity has to be discharged into the environment as gaseous and liquid waste. The activity passed into fresh water, together with the waste from research and smaller power reactors, reaches only a few mCi to a Ci in a year. The example of the 237-MW(e)-demonstration power reactor Gundremmingen on the Danube shows that about 30 Ci of radioactive waste was passed into the river in 1967. About 88% of this activity was caused by ^{3}H, the rest by different fission and radioactive corrosion products. The radioactive burden in the river in the range of the power plant, caused by natural and fallout nuclides, was at least 2000 Ci during the same time, more than 99% resulting from ^{3}H. The study of the behavior of radioactive substances in fresh water is of importance. The knowledge of the concentration processes of radioactive substances allows us to estimate the risk connected with the discharge of radioactive waste; thus it is possible to lay down river standards which are not dangerous for the population concerned. (auth)

26010 SAFETY ASPECTS OF REACTOR PHYSICS AND THE FORMATION OF FISSION PRODUCTS. Winkler, W. (Univ., Bern). Neue Tech., B; 12: 155-9(Oct 1970). (In German).

Several aspects of reactor safety are discussed. The magnitude of safety problems is compared with that encountered in chemical industry. Comparison shows that, as far as toxicity is concerned, reactor products and poisonous gases occupy the same order of magnitude. Subsequently, energy production in nuclear power plants is discussed. Events caused by prompt criticality are outlined. Finally, both amount and removal of radioactive fission products are assessed. (H.B.G.)

26011 TECHNICAL SAFETY MEASURES AND PRECAUTIONS. Kellermann, O. (Instituts fuer Reaktorsicherheit, Cologne). Neue Tech., B; 12: 159-66(Oct 1970). (In German).

Safety measures for reactors are discussed with respect to: radioactive fission products, fissionable material, cladding of fuel elements, cooling system, testing, safety installations, emergency cooling system, containment, efficiency of safety procedures, and the effects of external interference. (H.B.G.)

26012 SAFETY BALANCE OF REACTORS. Gruemm, H. (Reaktorzentrum, Seibersdorf, Austria). Neue Tech.; 13: 16-21 (Jan 1971). (In German).

Reactor safety is discussed with respect to environmental effects under normal operation. The probability of nuclear accidents is assessed as to professional personnel and population. It is concluded that either lack of information or misinformation of the public may lead to such a delay in the construction of nuclear power plants that pollution by fossil fuel installations may assume critical proportions. 10 references. (H.B.G.)

Power Conversion Systems

Refer also to abstract 24939.

Research and Test Reactors

Refer also to abstracts 25729 and 25957.

26013 (AAEC/LIB/Bib-265) CRITICALITY DATA FOR URANIUM ISOTOPES ^{235}U; URANYL NITRATE, URANYL NITRATE/UF_6 MIXTURES AND URANIUM DIOXIDE/TRICHLOROETHYLENE. A Bibliography. Literature search, 1948-1970. Geue, Jean (comp.) (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jan 1971. 56p. Dep. NTIS (U. S. Sales Only).

Four hundred and thirteen references are listed covering the period 1941 to 1970. Arrangement is chronological by year and alphabetical by author within each year. Reference is made to an abstract for each article. (Australia)

26014 (ANL-7700) PROTOTYPE ANALOG REACTIVITY METER FOR EBR-II. Karvinen, J. R.; Hyndman, R. W.; Call, R. A.; Price, C. C. (Argonne National Lab., Ill.). Feb 1971. Contract W-31-109-eng-38. 24p. Dep. NTIS.

A prototype analog reactivity meter has been developed for EBR-II. Accepting an amplified signal that is proportional to reactor power, the meter uses integrated circuitry to manipulate the incoming signal according to point-kinetic reactor theory and produces a direct readout of reactivity in inhours. This meter, which has been used to monitor all EBR-II operations since July 1969, obtains the first derivative of the neutron flux using a filtered differentiator and incorporates six delayed-neutron groups using closed-loop dynamics. The meter has a frequency response from dc to 40 Hz and can measure reactivity changes with an accuracy of 0.1 Ih (0.03 ¢). 6 references. (auth)

26015 (ANL-7774) STUDIES OF FISSION-GAS DISENGAGEMENT AND TRANSPORT PHENOMENA FOR FFTF FUEL-FAILURE DETECTION. Sowa, E. S.; Verber, F.; Goldfuss, G. T. (Argonne National Lab., Ill.). Jan 1971. Contract W-31-109-eng-38. 55p. Dep. NTIS.

A series of studies was conducted with the Fuel Failure Detection Loop (FFDL) on fission-gas disengagement from flowing sodium. Fission-gas injections into flowing and stagnant sodium were followed by measurement of the dynamic disengagement behavior at the upper gas blanket regions located at the top of the loop. The studies were divided into five phases: water mockup injection of radiokrypton to observe expected behavior of riser flow systems; initial experiments with gas injections into sodium flowing at 10 fps with temperature at 1000 and 1100°F, respectively; injections into sodium flowing at 7, 5, 3, and 2 fps with temperatures of 500 and 1000°F; tests with the upper riser replaced with the prototype FEDAL module; tests of ^{133}Xe injections into sodium flowing at 0, 2, 4, and 8 fps with temperatures at 500 and 1000°F and with the FEDAL module on the loop. The results showed that hydrodynamic theory was confirmed and that the bulk of the gas separation occurred approximately 1½ min after injection for a lineal sodium flow rate of 10 and 7 fps in the injection zone. For lower flow rates, e.g., 5, 3, and 2 fps, gas separation was partitioned between the loop riser and surge tank. Similar results were obtained at 1000 and 500°F, respectively. Tests with the FEDAL module prototype demonstrated effective gas separation at 500, 800, and 1100°F with circulating gas flow at 1 ft^3/min. Flooded level operation was more effective than with the internal cascade, recovery time being within 48 secs. The behavior of ^{133}Xe was found to be identical to that of ^{85}Kr. (10 references) (auth)

26016 (ANL/EBR-35) LOCAL MODIFICATION OF IRRADIATION CONDITIONS. Miller, L. B.; Jarka, R. E. (Argonne National Lab., Ill. Argonne National Lab., Idaho Falls, Idaho). Jan 1971. Contract W-31-109-eng-38. 34p. Dep. NTIS.

Over the past two years, methods have been developed to analyze the detailed spatial variations in neutron- and gamma-flux levels that occur in heterogeneous reactors. These methods have been used to investigate the degree to which the irradiation conditions can be modified in a small region of the core and then to define a core-loading pattern for EBR-II tailored to provide a specified gamma-flux level in a particular experimental-irradiation subassembly (XX03). In the tailored core loading, the gamma-heating rate in the stainless steel components of the subassembly will be 39% less than the gamma-heating rate in the same position in the unperturbed core. (auth)

26017 (BNWL-563) ENERGY DEPOSITION DISTRIBUTION IN THE FTR. Bunch, W. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). 6 Sep 1967. 12p. Dep. NTIS.

A preliminary estimate of the energy deposition pattern in the FTR was made for a 1000 liter, oxide-fueled reference core operating at 400 MW. It was assumed that 215.5 MeV will be generated as a result of each fission event, with the energy being distributed among the fission fragments, neutrons, and beta and gamma radiation. For the reference composition, it is estimated that over 95% of the energy will be deposited within the core, with about 90% being deposited directly within the fuel.

26018 (CNEN-RT/ING-70-1) RECOMMENDED SEISMIC DESIGN CRITERIA FOR A NUCLEAR FACILITY AT BRASIMONE, ITALY. Housner, G. W. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1970. 31p. NTIS (U. S. Sales Only).

The geological and seismic situation in the Brasimone site are considered and an evaluation of the largest earthquake expected is made. Then, design recommendations based on the design spectrum method complete the report. An example of the design spectrum method is reported in the appendix. (INIS)

26019 (CONF-710301-7) EFFECT OF CROSS SECTION VARIATION ON INTEGRALS MEASURED IN THE CFRMF. Scoville, J. J. (Idaho Nuclear Corp., Idaho Falls). [1970]. 8p. Dep. NTIS.

From 3. conference on neutron cross sections and technology; Knoxville, Tenn. (15 Mar 1971).

Relative capture cross section integrals for a variety of materials have been measured in the Coupled Fast Reactivity Measurement Facility. A knowledge of the flux spectrum (peaking at about 350 keV) allows the calculation of these relative integrals from differential data where it is available. Activation integral measurements of Au, $^{238}U(n,\gamma)$, and $^{235}U(n,f)$ are described. The experimental results are compared to calculations employing ENDF/B-II data and reveal inconsistencies beyond that expected

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from experimental error. These inconsistencies cannot be resolved by arbitrary adjustment of the cross section of any one of the materials. Various schemes of cross section variations and their effect on the integrals are presented. Energy dependent reaction rates have been plotted for each of the three materials. These are discussed in terms of specific energy regions and their importance to the total integral. 3 references. (auth)

26020 (DOCKET-50184-28) NATIONAL BUREAU OF STANDARDS REACTOR. Operations Report No. 10, July–December 1970. (National Bureau of Standards, Washington, D. C.). 31 Mar 1971. 10p. Dep. NTIS.

26021 (GA–10152) MEASUREMENT AND ANALYSIS OF DOPPLER REACTIVITIES IN THE THERMIONIC CRITICAL EXPERIMENT, ASSEMBLY NO. 1. Sargis, D. A.; Moore, R. A.; Sharp, R. (Gulf General Atomic, Inc., San Diego, Calif.). 1 Jul 1970. Contract AT(04-3)-167. 68p. Dep. NTIS.

Doppler reactivities have been measured for ^{238}U, tantalum, niobium, tungsten, dysprosium oxide and samarium oxide over a temperature range from 50 to 450°C in the Thermionic Critical Experiment, Assembly No. 1. A new experimental technique was employed in which periodic temperature oscillations of one inch diameter spherical samples were accomplished using a flowing stream of helium gas. Preliminary analysis indicates that the measured Doppler reactivities of all six nuclides are over-predicted by calculational methods typically used in design calculations. Improvements in analysis methods which could reduce the discrepancies are discussed. 27 references. (auth)

26022 (GEMP–647) TEST PROGRAM AND PROCEDURES FOR ADDITIONAL REACTIVITY MEASUREMENTS ON CONFIGURATION 9 OF THE WAVE EXPERIMENTS: CAVITY REACTOR CRITICAL EXPERIMENT. Pincock, G. D. (General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs). 4 Nov 1968. 12p. Dep. NTIS.

The test program and procedures for some reactivity measurements to be obtained from the Cavity Reactor are described. Configuration 9 of the wave experiments will be used and measurements will be made to determine the core average fuel worth, the reactivity penalty of rounding the corners at the ends of the reactor, and the reactivity worth of shortening the fueled region one stage (2.875 in.). 2 references. (auth)

26023 (GEMP–654) TEST PROGRAM AND PROCEDURES FOR CAVITY REACTOR, COMPLETE MOCKUP OF FLOWING GAS POWER REACTOR. Pincock, G. D. (General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs). 16 Dec 1968. 15p. Dep. NTIS.

The test program and procedures are described for a cavity reactor critical experiment to be performed at the Low Power Test Facility. The cavity region will mockup the cold startup conditions of a cylindrical cavity reactor including variable hydrogen and variable fuel densities. There will be a stainless steel liner on the cavity wall and an annulus of MTR type fuel plates in the radial reflector. 2 references. (auth)

26024 (GEMP–670) TEST PROGRAM AND PROCEDURES FOR A SEVEN MODULE CAVITY REACTOR CRITICAL EXPERIMENT. Pincock, G. D. (General Electric Co., Idaho Falls, Idaho. Nuclear Systems Programs). 3 Mar 1969. 15p. Dep. NTIS.

The test program and procedures are described for a cavity reactor critical experiment to be performed at the Low Power Test Facility. The cavity region will be modified to mockup a seven module "light bulb" concept of the cavity reactor. Each module will be 45.7 cm in diameter and will extend over the length of the cavity region. The space not occupied by the modules and structure material will contain D_2O. (auth)

26025 (GEMP–684) TEST PROGRAM AND PROCEDURES FOR A SEVEN MODULE CAVITY REACTOR CRITICAL EXPERIMENT WITHOUT COOLANT SIMULATION. Pincock, G. D. (General Electric Co., Idaho Falls, Idaho. Nuclear Systems Programs). 30 Apr 1969. 9p. Dep. NTIS.

The test program and procedures are described for a seven module "light bulb" cavity reactor critical experiment with no hydrogen (coolant) simulation in the modules. The ratio of the fuel radius to module radius will be 0.55. The experiment will be performed at the Low Power Test Facility (LPT) using the cavity reactor assembly which has been in operation on many other reactor experiments. 2 references. (auth)

26026 (GEMP–691) TEST PROGRAM AND PROCEDURES FOR A SEVEN MODULE CAVITY REACTOR CRITICAL EXPERIMENT WITH THE FUEL TO MODULE RADIUS RATIO OF 0.38. Pincock, G. D. (General Electric Co., Idaho Falls, Idaho. Nuclear Systems Programs). 15 May 1969. 10p. Dep. NTIS.

The test program and procedures are described for the seven module "light bulb" reactor with the fuel elements loaded so that the ratio of the fuel radius to the module radius is 0.38. The fuel elements will contain hydrogen (coolant) simulation. The experiment will be performed at the Low Power Test Facility (LPT) using the cavity reactor critical experiment assembly which has been in operation since 1966. 2 references. (auth)

26027 (GEMP–693) TEST PROGRAM AND PROCEDURES FOR A THREE MODULE CAVITY REACTOR CRITICAL EXPERIMENT. Pincock, G. D. (General Electric Co., Idaho Falls, Idaho. Nuclear Systems Programs). 27 May 1969. 15p. Dep. NTIS.

The test program and procedures are described for the three module "light bulb" cavity reactor critical experiment to be performed at the Low Power Test Facility at the Idaho Test Station. The major cavity, which is 6 ft in diameter by 4 ft long, will contain a three module tank. Each module will contain a fuel element with fuel loaded out to a diameter which is 0.55 times the module diameter. The hydrogen coolant will be simulated. The region between the modules will be filled with D_2O. 2 references. (auth)

26028 (INR–1183) CALORIMETRIC EXPERIMENTS ON REACTOR EWA-10 IN MARCH AND DECEMBER 1968. Knott, J.; Nemec, J.; Jirousek, V.; (and others) (Institute of Nuclear Research, Warsaw (Poland)). May 1970. 24p. NTIS (U. S. Sales Only).

Two calorimetric experiments carried out on reactor EWA-10 are described. A brief explanation is presented of the design and calibration of the calorimeters and results of measurements. Important results are represented graphically. (auth) (INIS)

26029 (JEN–220-DF/I-63) STUDY OF STRONGLY MULTIPLYING SUBCRITICAL MEDIA WITH PULSED NEUTRON SOURCE. Olarte Marin, F. J. (Junta de Energia Nucleare, Madrid (Spain)). 1970. 171p. (In Spanish). Dep. NTIS (U. S. Sales Only).

Three experimental non-stationary techniques—the die away method, the dispersion lay method, and the modified techniques of pulsed source—are presented, developed experimentally, and used for the calculation of the nuclear parameters of two very subcritical multiplying media with theoretical reactivities of −22.8 and −61 $. The experimental system is first described. Each technique and the development of the theoretical model are described in detail. The theoretical models used are completely inadequate to explain the analysis of the curves by the dispersion law, but can be used for the other two non-stationary techniques. (J.S.R.)

26030 (JUL–693-RE) THE INFLOW AND HEAT ENGINEERING INTERPRETATION OF THE FRJ-1 REACTOR CORE FOR THE 10-MW OPERATION. Katscher, W. (Kernforschungsanlage, Juelich (West Germany). Zentralabteilung Forschungsreaktoren). Aug 1970. 74p. (In German). Dep. NTIS (U. S. Sales Only).

Inflow and heat engineering studies on the new fuel and absorber elements of the MTR type, which were carried out in reference to the future operation of the swimming pool reactor FRJ-1 with a power of 10 MW, are described. The inflow measurements in the fuel element of the central core region of the research reactor extended to the measurement of the pressure loss/through-put characteristics, determination of the coolant through-put distribution on the individual gaps of the fuel and absorber elements, determination of the velocity profile in the external coolant gap of the standard fuel element, and velocity measurements in the gap between the fuel elements. The latter measurement forms the principal part of the inflow studies. In contrast to the present fuel element type with external fuel-free plates, the new fuel element concept contains external fuel plates. The knowledge of the inflow processes in the gap between the fuel elements is essential for the evaluation of the heat-engineering design. The measurements showed that the reactor core, compared with lateral inflow through simple structures, is not sufficiently coated. A cladding of the core with an aluminum case was proposed. Measurements in a 5×2 fuel-element core clad with Al confirmed the utility of this precaution. Heat engineering calculations were made with which it can be concluded that the new fuel and absorber elements are operationally safe. 24 references. (tr-auth)

26031 (NP–18711) PROGRESS REPORT ON REACTOR RESEARCH, 1969–1970. (Interuniversitair Reactor Instituut, Delft (Netherlands)). 62p. (In Dutch). Dep. NTIS (U. S. Sales Only).

The studies made in physics, reactor physics, chemistry, and radiation hygiene and radiation dosimetry are summarized. The results of significant experimental and theoretical work were pub-

lished in the literature, and these citations are tabulated. Future studies are indicated. (J.S.R.)

26032 (ORNL-TM-3322) NEUTRON FLUX SPECTRUM IN THE HFIR TARGET REGION. Kam, F, B. K.; Swanks, J. H. (Oak Ridge National Lab., Tenn.). 18 Mar 1971. 31p. Dep. NTIS.

The neutron flux spectrum in the HFIR has been determined with computer codes ANISN and THERMOS. This spectrum was used to calculate the reaction rates of several flux monitors for which measurements were made. The results of the calculations and the measurements agreed within ±10%. 5 references. (auth)

26033 (ORNL-TM-3355) BULK SHIELDING FACILITY QUARTERLY REPORT, OCTOBER–DECEMBER 1970. Tabor, W. H.; Hurt III, S. S. (Oak Ridge National Lab., Tenn.). 16 Mar 1971. 25p. Dep. NTIS.

The BSR operated 75.2% of the time at an average power level of 1,477 kW during October, November, and December of 1970. Water-quality control in both the reactor primary and secondary cooling systems was very satisfactory. There were four unscheduled shutdowns, three of which were caused by shim rods dropping and one by an experiment malfunction. Of the three unscheduled shutdowns caused by the dropping of shim rods, two were caused by the No. 3 shim rod and one by the No. 6 shim rod. A change was made in the No. 5 shim-rod-drive unit, as authorized by Reactor Instrument and Controls Design Change Memo No. BSR-2Mw-26. This change authorized the installation of a nickel-plated armature on the No. 5 shim rod. The PCA was operated for two days during this quarter as a training aid for students from the University of Kentucky. (auth)

26034 (RISO-M-1215) CALIBRATION OF AIRBORNE AND GASEOUS ACTIVITY MONITORS USED IN THE DR 3 REACTOR BY ^{41}Ar AND ^{133}Xe. Zak, W. M.; Walmod-Larsen, Ole (Danish Atomic Energy Commission, Risoe. Research Establishment). Dec 1970. 15p. Dep. NTIS (U. S. Sales Only).

Radiation measuring instruments used in the DR 3-reactor have been calibrated for gaseous and airborne particulate activity. The monitors concerned are: fission gas station monitor; gamma air duct monitors; the stack monitor; and moveable health physics air monitors available in the plant. Calibration methods and the calibration curves against ^{41}Ar and ^{133}Xe as well as the energy response curves are described and shown. 2 references. (auth)

26035 (STI/PUB-225) SAFE OPERATION OF CRITICAL ASSEMBLIES AND RESEARCH REACTORS, 1971 EDITION. CODE OF PRACTICE AND TECHNICAL APPENDIX. Safety Series No. 35. (International Atomic Energy Agency, Vienna (Austria)). 1971. 201p. IAEA $5.00.

Procedures and equipment for safe operation of critical assemblies and research reactors are described. A listing of operations incidents for critical assemblies and research reactors is presented. (D.C.C.)

26036 (WHAN-FR-13) ANALYSIS OF ZPPR/FTR SHIELD EXPERIMENTS: GAMMA DISTRIBUTION. Boulette, E. T.; Bunch, W. L. (Hanford Engineering Development Lab., Richland, Wash.). Feb 1971. Contract AT(45-1)-2170. 48p. Dep. NTIS.

The coupling of one-dimensional transport theory with two-dimensional diffusion theory is shown to be a practical method for realistically predicting measured γ flux distributions throughout the core, reflectors, shield, and stored fuel zone of assembly FTR-2 in the Zero Power Plutonium Reactor (ZPPR). Two-dimensional diffusion theory calculations were used to generate the neutron flux distribution upon which the volumetric γ source was based. It is also demonstrated that γ yields for thermal neutron capture will realistically predict the γ flux distribution in a fast reactor environment, such as the FTR. (20 references) (auth)

26037 FAST NEUTRON SPECTRAL MEASUREMENTS IN WATER USING PROTON-RECOIL DETECTORS. Paulson, Carl Keith. Lafayette, Ind.; Purdue Univ. (1970). 325p. University Microfilms Order No. 71-2667.

Thesis.

Fast neutron spectrometers with the capability of accurately determining neutron spectra in the slowing down region of a reactor are a recent development. The system which has produced the best results to date employs proton-recoil detectors and pulse shape discrimination to distinguish gamma pulses from neutron pulses. Proton-recoil detectors, one filled with methane for measurements greater than 200 keV, and one filled with hydrogen for the energy region below 200 keV were used for the measurements presented. The measurements are energy spectra variations in water at three distances from the Purdue University Reactor-I. The energy region considered was 25 keV to 1 MeV. Although crude measurements using threshold foils and several angular dependent studies have been made, no detailed four-pi measurements are available. The measurements also establish the energy flux distribution which is available to materials put into the reactor pool. (Diss. Abstr. Int., B)

26038 FAST NEUTRON SPECTROSCOPY. Glynn, James Codyre. College Park, Md.; Univ. of Maryland (1970). 108p. University Microfilms Order No. 71-4906.

Thesis.

The National Bureau of Standards research reactor fast neutron spectrum was measured from 300 keV to 1800 keV using a helium-3 solid state spectrometer. A study of the spectrometer characteristics, the design of a collimation system to extract a neutron beam which could be related to the in-core neutron flux, and a data analysis program are described. The method of analysis applied to the pulse height spectra corrected for spectrometer resolution, streaming effects and anisotropies introduced by the system is presented. (Diss. Abstr. Int., B)

26039 REACTIVITY BALANCE FOR REACTOR DIAGNOSIS. I. ACCURACY OF REACTIVITY BALANCE TECHNIQUE IN HITACHI TRAINING REACTOR. Ohsawa, Yasuo; Kato, Kanji (Hitachi Ltd., Kawasaki, Japan). J. Nucl. Sci. Technol. (Tokyo); 8: 122-8(Mar 1971).

The reactivity balance method commonly used for measuring inserted anomalous reactivities was applied to the HTR (Hitachi Training Reactor). The reactivities taken into consideration included the kinetic reactivity, as well as those associated with the control rod, power feedback, coolant inlet temperature and Xe buildup. The reactivity balance data were obtained to cover start-up operation, as well as at various power levels including full rated power. These results obtained show that the errors associated with power feedback and with Xe buildup reactivity are both below approximately 1 cent, these errors being due to the one point approximation and to inaccuracies in the constants used in the equations. The fluctuations of residual reactivity are attributed to power fluctuations, to uncertainties in the measurement of the coolant inlet temperature and in the determination of control rod position. The scattering about the zero reactivity line caused by these fluctuations was evaluated to be within 0.8 cent. Anomalous reactivity was inserted artificially by means of shim rod movement, and was detected. The discrepancy between the residual reactivity calculated by this method and the actual worth of the inserted anomalous reactivity, which was a measure of the sensitivity of this technique, was within 1 cent. (auth)

26040 DAMAGES TO THE SHIELDING AND TO THE CORE TANK OF THE KARLSRUHE RESEARCH REACTOR FR2. Schmidt, Werner Paul (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). Z. Tech. Ueberwach.; 9: 405-9(1968). (In German). (KFK-936).

After one year of operation, leaks developed in the thermal shield and in the containment vessel of the Karlsruhe research reactor FR 2. The defects were discovered during routine inspections. Repair work yielded valuable experience about replacement of containment vessels. The leaks are discussed with respect to effects, determination of both size and location, procedures for continuation and restarting of reactor operations, and underlying causes. (tr-auth)

26041 AMERICAN NATIONAL STANDARD: SAFETY IN CONDUCTING SUBCRITICAL NEUTRON-MULTIPLICATION MEASUREMENTS IN SITU. ANSI N 16.3 1969. Hinsdale, Ill.; American Nuclear Society (1970). 3p. Available from American Nuclear Society, Hinsdale, Ill.

Safety guidelines are presented for conducting subcritical neutron multiplication measurements in areas where physical protection of personnel against the consequences of a criticality accident is not provided. (H.D.R.)

26042 SEFOR FOLLOW-ON PROGRAM. Olds, F. C. Power Eng.; 75: No. 3, 44-7(Mar 1971).

The proposed scheduling of research projects for the SEFOR follow-on study is reviewed. Potential research programs are described. (D.C.C.)

26043 MEASUREMENTS FOR DESIGN OF THE CORAL-I FAST EXPERIMENTAL REACTOR. Gutierrez Bernal, R. Energ. Nucl. (Madrid); 14: 227-43(May-Jun 1970). (In Spanish).

The principal characteristics of the CORAL-I fast reactor and a general description of its control and safety elements are summarized. The experimental determination of the minimum critical charge, calibration under reactivity of the different control

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and safety elements, calibration of the reactor power, measurement of the temperature coefficient, and measurements of stability and reproducibility are described. The most significant experimental values are reported and compared with theoretical values. (tr-auth)

26044 DISPERSION RELATION APPROACH FOR NEUTRON WAVES IN MULTIPLYING PRISM. Wada, Morihiro; Utsuro, Masahiko (Kyoto Univ.). Annu. Rep. Res. Reactor Inst., Kyoto Univ.; 3: 107-20(1970).

Neutron wave propagation experiments are carried out in two natural uranium-graphite systems with localized and widely distributed fuel rod arrangements. The dispersion relations are experimentally determined and compared with the theoretical values from an age-diffusion approximation. The results from the experiment with the distributed arrangement agree with the already published theory for homogeneous system, while those with the localized arrangement are explained by a theory for thermal neutrons in heterogeneous system which is presented. (auth)

26045 COLD NEUTRON SOURCES FOR THE HIGH-FLUX REACTOR AT GRENOBLE. Ageron, P. (CEN, Grenoble, France); Verdier, J.; Ewald, R.; Harig, H. D. Atomwirt., Atomtech.; 16: 125-9(Mar 1971). (In German).

Designed for the German–French high-flux reactor at Grenoble is an integrated cold neutron source for experimental purposes. Approximately 25 liters of liquid deuterium serve as moderator. The power will approach 7 kW at 25°K, while the neutron flux is estimated to reach 3.10^{15} at 0.005 eV. Reasons for selection of this unusual moderator are discussed. Described are the essential parts and the functional principle of the installation now under construction. Moreover, safety aspects associated with the installation are described in detail. 14 references. (H.B.G.)

26046 DEVELOPMENT OF AN ENERGY PROBE FOR SEFOR. Bumm, H.; Glauner, W.; Ruehl, E.; Schikarski, W. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). Atomwirt., Atomtech.; 16: 134-5(Mar 1971). (In German).

For SEFOR, an energy probe was developed that permits the measurement of power transients. The equipment essentially consists of an U–Nb cylinder on top of which a Ni–Cr–Ni–thermoelement is welded, a container with cooling ribs, and a ceramic ring that isolates the probe electrically from the instrument tube. Specifications were as follows: high sensitivity through sufficient amounts of fissionable material to obtain high signals; time constant of response should be less than 1 msec.; and time constant of heat conduction should be larger than 100 msec. As fissionable material, an alloy of 80% Nb and 20% U with an ^{235}U-enrichment of 90% was selected. The probe was tested in the cyclotron at Karlsruhe and in the research reactor at Munich. Results showed that specifications were met, and that the probe is suitable for measuring energy transients of SEFOR. 3 references. (H.B.G.)

Rocket and Space Reactors

Refer also to abstracts 23727, and 26022–26027.

26047 (N-70-20658) DESIGN AND DEVELOPMENT OF A VOLTAGE REGULATOR-EXCITER FOR THE SNAP-8 NUCLEAR-ELECTRICAL POWER-CONVERSION SYSTEM. Bradley, S. L. (Aerojet-General Corp., Azusa, Calif.). Oct 1969. Contract NAS5-417. 81p. (NASA-CR-72645; AEROJET-3658). NTIS.

A voltage regulator-exciter was developed for the 60 kW alternator used in the SNAP-8, Rankine-cycle, nuclear space power system. Performance and endurance tests were conducted and the test results indicated that the voltage regulator-exciter subsystem would provide reliable voltage regulation performance exceeding the specification requirements for load changes of no load to full load. The design and tests conducted including test results obtained during the development of the voltage regulator are described. (auth) (STAR)

26048 (N-70-24347) DEVELOPMENT OF SPEED CONTROL FOR THE SNAP-8 ELECTRICAL GENERATING SYSTEM. Bradley, S. L. (Aerojet-General Corp., Azusa, Calif.). Nov 1969. Contract NAS5-417. 57p. (NASA-CR-72670; AEROJET-3114). NTIS.

The design, fabrication and testing of the speed control used on the SNAP-8 electrical generating system are discussed. A total of more than 10,000 hours of operation with the electrical generating system has provided information which verified that the speed control was capable of regulating the speed of the system to within + or −1%, with an output frequency of 400 + or −4 Hz. Test results are presented along with an evaluation of the speed control performance relative to the SNAP-8 electrical generating system. (auth) (STAR)

26049 (N-71-11781) EXPERIMENTAL INVESTIGATION OF CONDENSER PRESSURE CONTROL DURING SNAP-8 STARTUP. I. INVENTORY CONTROL OF CONDENSING PRESSURE. Tew, Roy C.; Fisher, Roland C. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Nov 1970. 24p. (NASA-TM-X-2114; E-5731). NTIS.

An inventory method for controlling the mercury condensing pressure during SNAP-8 startup was tested. With this method liquid mercury flows into or out of the system, maintaining pressure equilibrium with a constant pressure reservoir. It was found that to have adequate control sensitivity, the control must operate in the high inventory region of the condenser. Also, the condenser coolant (NaK) flow schedule was found to be a critical factor in achieving satisfactory control during startup. Pressure control was satisfactory for some of the startups; however, it appears doubtful that a NaK flow ramp to the self-sustaining level can be found which would allow satisfactory control for the expected variety of startups. (auth) (STAR)

26050 NUCLEAR POWER PLANTS FOR SPACE APPLICATIONS. Budnick, Dietrich (Siemens Aktiengesellschaft, Erlangen, Ger.). Siemens Rev.; 38: 3-7(Jan 1971).

The development of incore thermionic reactor for space applications is reviewed. Design characteristics of the reactor type are presented. 18 references. (D.C.C.)

26051 KERNTECHNIK BEI SATELLITEN UND RAKETEN. (Nuclear Engineering for Satellites and Rockets). Loeb, Horst. Thiemig-Taschenbuecher, Band 36. Muenchen: Verlag Karl Thiemig KG (1970). 414p. DM 24.80. (In German and English).

Worldwide developments in nuclear power for space vehicle energy supplies and propulsion are reviewed. Topics discussed include: basic energy requirements of rockets and satellites; radioisotopic batteries and auxiliary power reactors; and nuclear-electric and nuclear-thermal propulsion systems. The physical principles, basic technology, and international developments are summarized for each energy supply concept, and German developments in the field are described. (H.D.R.)

Process Heat and Desalination Reactors

Refer also to abstract 25845.

26052 RESEARCH FOR THE WORLD FOOD CRISIS. A Symposium Presented at the Dallas Meeting of the American Association for the Advancement of Science, December 26–31, 1968. Aldrich, Daniel G. Jr. (ed.). Publication No. 92. Washington, D. C.; American Association for the Advancement of Science (1970). 332p. $12.50. (CONF-681231).

Included are 14 papers on worldwide food production, basic research in food production, and the progress of agricultural research and development in various regions of the world. A separate abstract was prepared for one paper on nuclear powered agro-industrial complexes. (H.D.R.)

For an abstract of an individual paper see: 26053.

26053 NUCLEAR POWER IN AGRO-INDUSTRIAL DEVELOPMENT. Hammond, R. Philip (Oak Ridge National Lab., Tenn.). Amer. Ass. Advan. Sci., Symp.; No. 92, 211-27(1970).

From Symposium on Research for the World Food Crisis, Dallas, Tex. See CONF-681231.

A spectrum of costs is presented that shows the usefulness of energy in agriculture depends upon a careful matching of needs, efficiencies, costs, and technologies. Before it can be widely used for low-efficiency, low-value crops, society must learn to build cheaper reactors and evaporators, to increase yields, and to manage the soil moisture in the optimum fashion. For high-value crops the cost of the water is not so important as reliability and ubiquity. For such crops, new degrees of freedom are created in location, crop timing, and certainty of outcome by the ability to use desalted water. Energy to create water, improve soil, make fertilizer, mechanize production, and to streamline conversion to finished foods will make man's control of his food supply more reliable and profitable and more comparable to his achievements in other fields. (auth)

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26054 METHOD OF AND PLANT FOR THE UTILIZATION OF NUCLEAR ENERGY. (to Kernforschungsanlage Julich Gesellschaft Mit Beschrankter Haftung). British Patent 1,225,014. 17 Mar 1971. Priority date 17 Feb 1967, Germany.

HYDROGEN — production by process heat reactor, method for
REACTORS, PROCESS HEAT — design with means for production of hydrogen by reaction of metal oxide, steam and carbon monoxide (H.D.R.)

26055 CHEMISTRY AND NUCLEAR POWER. Winnacker, K. (Fabwerke Hoechst AG, Frankfurt am Main). Chem.-Ing.-Tech.; 43: 1-10(Jan 1971). (In German).

Construction of nuclear power stations in the immediate neighborhood of centers of heavy chemical industry has the double advantage of coupled production of electricity and process steam.. As a result of the lower price of electricity compared with that produced in conventional steam power stations, interest in classical electrochemical processes and electrothermal techniques is being rekindled. A further close association between the chemical industry and nuclear technology is arising out of the wide range of new problems encountered in the production and reprocessing of nuclear fuels and the manufacture of moderators. Further points of contact between chemistry and nuclear energy are also found in analysis and measuring techniques as well as in methods of radiochemical preparation. A review is given of the development of these common fields of activity. (auth)

26056 AN AGRO-INDUSTRIAL COMPLEX IN THE GANGETIC PLAIN. Sarabhai, V. A. (Atomic Energy Commission, Bombay). pp 3-30 of Proceedings of the Seminar on Nuclear Power. /Rastogi, B. P. (ed.). Bombay; Department of Atomic Energy (1970). (CONF-700113-9).

From Seminar on Nuclear Power, Bombay, India.

A plan for an agro-industrial complex based on nuclear power is proposed for the development of western Uttar Pradesh (India). This complex involves a power station with two nuclear reactors, each of 600 MW(e) capacity. Nuclear power will be used for the production of nitrogen and phosphate fertilizers, an Al plant, and to supply energy to tube wells for irrigation. The total area covered under this plan is 1.5 million hectares. This region has been selected for the project because of the availability of underground water in sufficient quantities for intensive cultivation with two and three crop rotations. The total investment in power costs and agricultural economics in this region has been studied and the groundwater potential estimated. A more precise and quantitative estimate of the underground water and determination of aquifer conditions has been planned. Groundwater movement will be studied with tritium as tracer. The total investment in the industrial complex will be about U. S. $567 million and the overall return expected with the successful implementation of the project is about 68% on incremental invested capital with mechanized farming. The scope of a "limited" complex, utilizing currently available technologies, is also estimated. Factors relating to the success of the project, such as the logistics of the movement of large quantities of raw materials in and out of the complex, storage requirements and the problems of management, have been examined in detail. (INIS)

Marine and Portable Power Reactors

26057 (JNS-8) AFFIRMATION TESTS ON THE ARRANGEMENTS IN THE REACTOR CONTAINMENT VESSEL AND REACTOR ROOM FOR THE FIRST NUCLEAR-POWERED SHIP. (Japan Nuclear Ship Development Agency, Tokyo). Nov 1969. 26p. (In Japanese). Dep. NTIS (U. S. Sales Only).

Major equipment, instruments, etc. of the reactor system are located in the reactor room and the reactor containment vessel in the first nuclear-powered ship "Mutsu". Because of the limited space aboard, the works of installation and subsequent maintenance and repair present considerable difficulties, due also to the radioactivities induced in reactor operation. Affirmation tests in this connection have been carried out with the mockup of reactor containment vessel and reactor room, plus various facilities. The test procedure and the findings for each item of affirmation are described. The affirmation tests included the following: exchange of the heaters for a pressurizer; exchange, position adjustment, etc. of neutron detectors; exchange of the fuels; maintenance and repair of machines with rotating parts; plugging in the heat exchangers; maintenance and repair of valves; and the same for fitting plates for electric wires penetrating the containment vessel. (Japan)

26058 NUCLEAR PROPULSION OF MERCHANT SHIPS. Boxer, Leslie (European Nuclear Energy Agency, Paris). OECD (Organ. Econ. Coop. Develop.) Observ.; No. 48, 27-31 (Oct 1970). (In French).

Some of the advantages presented by nuclear propulsion ships and the problems encountered with them are reviewed. (auth) (France)

Reactor Theory

Kinetics

Refer also to abstracts 23829, 25624, 25725, 25965–25969, 26029, and 26044.

26059 (CNEN-RT/FI-70-19) HETEROGENEITY EFFECTS ON THE ADJOINT FUNCTION AND RELATED QUANTITIES IN FAST REACTORS. Bitelli, G.; Cecchini, G.; Gandini, A. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1970. 19p. NTIS (U. S. Sales Only).

A method using collision techniques is developed which accounts for the heterogeneity effects on the adjoint function in the cell structure of fast reactors. A numerical example is shown relevant to the sodium void experiments on assembly 4Z of the ZPR VI critical facility. (INIS)

26060 (GEAP-5355-A) BURNUP: A FORTRAN IV CODE FOR COMPUTING U AND Pu FUEL BURNUP FROM U, Pu, AND Nd MASS SPECTROMETRIC MEASUREMENTS UPDATED TO INCLUDE FAST REACTOR FUELS. Rider, B. F.; Ruiz, C. P.; Peterson, J. P. Jr.; McLaughlin, T. V. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Development Operation). Revised Jan 1970. Contract AT(04-3)-189. 103p. Dep. NTIS.

This code correlates heavy element isotopic analysis with fission product Nd, U, and Pu concentrations in an irradiated U or U + Pu fuel for calculation of burnup (atom percent fission and MWd/MT). Certain reactor parameters including effective neutron absorption cross sections for all U and Pu isotopes, capture-to-fission ratios for ^{235}U, ^{239}Pu, and ^{241}Pu, a two-group description of the neutron spectrum, the average neutron temperature, the reactor fast fission factor, and the distribution of the sources of fission among the fissionable nuclides are computed from the experimental measurements. A description of the method, the equations used, and instructions for use of the code are included. (2 references) (auth)

26061 (LFEN-NI,-49-a) NUMERICAL TREATMENT OF THE RESULTS OF AN EXPERIMENTAL ROD DROP IN A NUCLEAR REACTOR. Oliveira, Jaime M. Costa (Junta de Energia Nuclear, Sacavem (Portugal). Laboratorio de Fisica e Engenharia Nucleares). 1969. 8p. (In Portuguese). Dep. NTIS (U. S. Sales Only).

The sub-programs of the LFEN-FR6 for the numerical calculation of the results of an experimental rod drop in a nuclear reactor are presented. The data input is described. (J.S.R.)

26062 (RISO-M-1346) SYNTRON: A THREE-DIMENSIONAL FLUX SYNTHESIS PROGRAMME. Larsen, Hans (Danish Atomic Energy Commission, Risoe, Research Establishment). Jan 1971. 33p. Dep. NTIS (U. S. Sales Only).

A description is given of the program SYNTRON, which is a three-dimensional variational single-channel flux synthesis code. Besides the actual synthesis, the program contains a subroutine for calculation of the two-dimensional expansion functions by use of ordinary difference equation technique. 13 references. (auth) (Denmark)

26063 (RPI-328-219) STANDARD CENTRAL COMPILATION OF THE RESULTS FOR INTEGRAL TESTS OF MICROSCOPIC DATA. Malaviya, B. K.; Gaerttner, E. R. (Rensselaer Polytechnic Inst., Troy, N. Y.). [1970]. Contract AT(30-1)-328. 5p. Dep. NTIS.

The continuing accumulation of the results of integral tests of differential-cross-section data from a variety of sources has raised the question of an appropriate mechanism for the presentation and systematic compilation of these results so as to channel the information to reactor design and data evaluation groups in a readily available and directly usable form. A proposed format for such a compilation is developed to bring together in a systematic, compact form the upcoming results of integral measurements and analyses of importance to fast-reactor analysis and development. The compilation format incorporates all the relevant details of the measurement and calculation and should considerably facilitate rapid and fruitful exchange of information relating to the evaluation of cross-section data based on integral studies. (auth)

26064 (RT/FI-(70)15) COMPARISON BETWEEN THE S_N AND CHARACTERISTICS METHODS FOR FAST REACTOR EVALUA-

TION. Galligani, I.; Sena, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 16 Mar 1970. 44p. Dep. NTIS (U. S. Sales Only).

A systematic numerical comparison is made between the S_N and characteristics methods in relation with fast reactor neutronic evaluations. In particular localized void, poison, and external source effects for a number of different geometries and compositions are studied. Extreme conditions of numerical validities are checked for both methods. 8 references. (auth)

26065 (UJV-2367.RP.) PROGRAM HEPAR. COMPUTATION OF PARAMETERS OF HETEROGENEOUS EQUATIONS BASED ON THE CELL-METHOD TRANSPORT THEORY. Rocek, J. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Mar 1970. 25p. (In Czech). NTIS (U. S. Sales Only).

A method of computing parameters of the equations of a heterogeneous system has been proposed, utilizing the relationship between the heterogeneous and the homogenizing methods for the case of a large bare pile with a uniform lattice. The basic parameters include the block radius, the absorption and production constants of the block, the life of thermal neutrons, the diffusion coefficient, and the diffusion length of thermal neutrons in the moderator. A computer program named HEPAR, written in the GIER code of ALGOL, was set up based upon the proposed method, and the heterogenous parameters of the A 1 reactor were computed. The input of the HEPAR program is described and the output is shown for this special case. (INIS)

26066 (UJV-2389R) CALCULATION OF SOME PARAMETERS NEEDED IN NOISE AND KINETICS MEASUREMENTS. Rypar, V. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). [nd]. 14p. (In Czech). NTIS (U. S. Sales Only).

Modified methods of calculating the effective ratio of delayed neutrons and the correction for delayed photoneutrons are described, suited for computer evaluation. Subsequently, the neutron parameters are calculated for the case of delayed neutron groups reduction, and the dependence of the Rossi-α constant on the lattice cell parameters is determined numerically. The results of calculations for the TR-O reactor are presented in graphs and tables. (INIS)

26067 NUMERICAL METHODS FOR REACTOR CALCULATIONS. Ortiz Fornaguera, R. Energ. Nucl. (Madrid); 14: 251-67(May-Jun 1970). (In Spanish).

The methods of finite differences for the numerical calculation of reactors are studied. The methods are based on the concepts of exterior and interior iterations, the equipoise iterative method, and the direct methods. 6 references. (tr-auth)

26068 ANALYTICAL COMPUTATION OF THE Pu BALANCE FOR A TWO-TYPE STRATEGY CONSISTING OF THERMAL CONVERTERS AND FAST BREEDERS. Locke, G. (Univ., Kiel). Atomwirt., Atomtech.; 16: 133-4(Mar 1971). (In German).

Mathematical formulas are developed for computation of the Pu balance for a converter-breeder system. Results of the analytical treatment are compared with numerical assessments for development of nuclear energy in West Germany from the year 1970 through 2000. It is assumed that in the year 2000 West Germany will possess nuclear plants producing a total power of 200 GW(e). Agreement between analytical and numerical method is satisfactory. Because of its simplicity, the analytical technique is suitable for strategy calculations about future nuclear energy planning. (H.B.G.)

26069 THEORY OF BEAM TUBES IN CYLINDRICAL GEOMETRY. Haring, G. (Technische Hochschule, Graz). Atomwirt., Atomtech.; 15: 537-8(Nov 1970). (In German).

Discussed are analytical aspects encountered during the solution of Boltzmann's equation by means of spherical functions for the calculation of neutron flux in reactors containing cavities, such as experimental loops, distance between core and shielding, and cooling spaces. Developed is a procedure which leads to differential equations that can be solved by common methods. The procedure permits a solution of the Boltzmann equation for the case of a multidimensional cavity as well as the neutron flux distribution in surrounding material. (H.B.G.)

Dynamics

26070 (LFEN-NI-47a) STUDY OF THE DYNAMIC BEHAVIOR OF A NUCLEAR REACTOR AFTER AN ABRUPT CHANGE IN REACTIVITY. Oliveira, Jaime M. Costa (Junta de Energia Nuclear, Sacavem (Portugal). Laboratorio de Fisica e Engenharia Nucleares). 1969. 30p. (In Portuguese). Dep. NTIS (U. S. Sales Only).

The solutions of the kinetic equations of a reactor without reflector, subjected to an abrupt change in reactivity, are obtained by means of the Laplace transformations, assuming that the reactor is in a stationary and critical state at the moment at which the change occurs. The concentrations of the delayed neutron precursors and the density of the neutrons are presented in the form of exponential sums in which the coefficient of the time variable is the exponent of each term is a root of the Hordheim equation and in which the coefficient of each term is proportional to the value of the residue corresponding to this root. The results of the calculation of the variation of the neutron density after an abrupt introduction of reactivity into the core of the RPI are presented. The effect of the eventual modification of the values of Λ and β_e on the results is also studied. Some recommendations of an experimental nature are made. 13 references. (tr-auth)

26071 COMPUTERIZED SOLUTION OF ONE-DIMENSIONAL DYNAMIC MODELS OF CATALYTIC FIXED-BED REACTORS. Luebeck, B. (Univ., Stuttgart). Chem.-Ing.-Tech.; 43: 97-102 (1971). (In German).

Model equations for catalytic fixed-bed reactors are distinguished by their non-linearity (reaction) as well as by their boundary value character (heat return). Their solution therefore presents considerable difficulties. In contrast to the differential analysis of the local differential quotients, a sum approximation of an integral representation of the model equations is used. The problem is reduced to repeated solution of a set of linear equations by use of suitable Taylor expansions of the non-linearity. This process can be used generally for analysis of systems exhibiting transient phenomena with non-linear source functions (catalytic tube reactors, nuclear reactors, separation processes). The programs require only short computing times. 14 references. (auth)

Experimental Applications

26072 (UJV-2381.RF.) COMPUTER PROGRAM FOR EVALUATION OF PULSATION EXPERIMENTS. Svoboda, C. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). [nd]. 10p. (In Czech). NTIS (U. S. Sales Only).

Formulas referring to background and measurement errors in pulsation experiments and to reactivity calculations by the Gozani and Garelis-Russel method are given. Program 1355/U devised for evaluation of pulsation experiments is briefly described. (INIS)

Reactor Components, Fuels, and Accessories

Refer also to abstracts 23531, 23724, 23768, 23799, 23909, 24535, 24536, 24614, 24619, 24620, 24663, and 25957.

26073 (AAEC/LIB/Bib-272) LEAK RATE TESTING OF REACTOR CONTAINMENT STRUCTURES. A Bibliography. Literature search, 1948-January 1971. Geue, Jean (comp.) (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Feb 1971. 19p. Dep. NTIS (U. S. Sales Only).

One hundred and one references are listed chronologically by year, and alphabetically by author within each year. References are made to abstracts for each article. The period covered is 1948 to January 1971. (Australia)

26074 (EURFNR-817) VARIATION IN THE THERMAL CONDUCTIVITY OF AN OXIDE FUEL ELEMENT DURING BURNUP. Kleykamp, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material- und Festkoerperforschung). Translation of report KFK-1245. 16p. Dep. NTIS.

Work Performed under United States-Euratom Fast Reactor Exchange Program.

The change in thermal conductivity of mixed-oxide fuel during burnup is discussed. The influence of the porosity and change in stoichiometry as well as the heat-transfer coefficient has been estimated. The formation of the fission products during burnup led to a decrease in thermal conductivity. The latter fell by 25% after a burnup of 10% due to the solid solution formation (U,Pu)-oxide-rare earth oxides-ZrO_2. An increase of about 8% compared with the pure matrix is to be expected in the case of metallic and oxide inclusions in dispersion form. 17 reference. (auth)

26075 (GEAP-13603) CENTER TEMPERATURE MEASUREMENTS OF MIXED OXIDE FUEL FROM ZERO TO 3,000 MWd/Te. Asamoto, R. R.; Bohaboy, P. E.; Sandusky, D. W.; Conti, A. E. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Development Operation). Nov 1970. Contract AT(04-3)-189. 50p. Dep. NTIS.

The center temperature and the power output of an encapsulated plutonium–uranium oxide fuel pin were directly measured during irradiation in GETR. Linear powers up to 15 kW/ft and central temperatures to 2100°C were measured during the experiment which extended to 3000 MWd/Te. The experimental results indicate a decrease in the effective thermal conductivity when the fuel pin is thermally cycled at center temperatures below 1650°C, and a gradual decrease in the heat transfer properties with increasing fuel burnups to 3000 MWd/Te. The first effect is attributed to irradiation damage and thermally induced cracking in the fuel which decreases the effective heat flow. This decrease disappears when the central temperature is increased to temperatures where fuel restructuring is possible. The second effect resulted in increased fuel center temperatures of 100 to 200°C when compared to fuel with essentially zero burnup. This relationship was noted for all linear powers to 15 kW/ft and for fuel center temperatures to 2100°C. (23 references.) (auth)

26076 (INIS-mf-23) HEAVY WATER. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jan 1970. 12p. NTIS (U. S. Sales Only).

The properties of heavy water are briefly covered, with application to reactor usage. The evolution in world production of D_2O is summarized, and the production is related to Australia's decision to construct a nuclear power station. (INIS)

26077 (INIS-mf-29) SOME STUDIES ON THE BURN-UP OF NUCLEAR FUEL. Forsyth, R. S. (Stockholm Univ. (Sweden)). Apr 1970. 32p. NTIS (U. S. Sales Only).

A short review of the problems involved, and the techniques used, in determining the burnup of nuclear fuel is given. Contributions on destructive and nondestructive analysis are described. The principles of the use of stable fission product nuclides are presented and illustrated by the use of the molybdenum stable fission product isotopes. The applications of both NaI detectors and Ge(Li) detectors for the gamma spectrometric examination of irradiated fuel are described. (INIS)

26078 A PRESSURE RESISTANT ENCLOSURE. Picaut, Jack; Puyo, Andre; Saglio, Robert (to Commissariat a l'Energie Atomique). French Patent 1,593,738. 1 Jun 1970. Filed 28 Nov 1968. (In French).

A pressure resistant enclosure encircled by many prestressed hoops evenly distributed along its length is described. Each hoop consists of many metal strands resting on pressure supports fixed at regular intervals around the periphery of the enclosure, and possesses an elastic securing device at the extremity of the outer edge of these strands. The enclosure possesses a means of controlling the tension of the strands by the introduction of wedges between the pressure supports and each hoop, the successive tightening of the hoops being accomplished by screw jacks between them. (auth) (France)

26079 VENTED FUEL ELEMENT. Dieumegard, Max (to Commissariat a l'Energie Atomique). French Patent 1,596,521. 22 Jun 1970. Filed 23 Jul 1968. (In French).

The invention concerns a vented fuel element containing a mass of fuel material encased in metallic cladding. It includes a fission gas evacuation vent situated at the top of the cladding and made up of a porous element creating a large pressure drop at the passage of these gases. The vent consists of a porous thermocouple wire with no electrical conductor, a crushed or drawn capillary wire or a porous tube of very small pore diameter. (France)

26080 ELECTRO-MECHANICAL DEVICE FOR DETECTING THE PRESENCE OF NUCLEAR REACTOR FUEL RODS. Pinault, J.; Lattet, J. (to Societe Anonyme. Groupement Atomique Alsacienne Atlantique). Canadian Patent 858,148. 8 Dec 1970. Priority date 4 Feb 1966, France.

The device is intended for use with a grab and detects the presence of nuclear fuel in a fuel element when it is being handled by the grab. The detector device has a body portion including a cylindrical sleeve of electrically insulating, non-magnetic material around which a coil is wound and within which is a displaceable magnetic core, first and second compressing springs operating in series and separated by a cup-shaped element. The second spring is stiffer than the first spring and there are means for connecting the cup-shaped element to the magnetic core. A mechanical probe is secured to a free end of the second spring and is capable of being displaced from a position to which it is normally biased by the springs to a position to which it is displaced by the fuel. The arrangement is such that movement of the probe will cause changes in the inductance of the coil. A remote electronic assembly is provided for detecting such changes of inductance. (Canada)

26081 GUIDE TUBE FOR A CONTROL ROD IN A NUCLEAR REACTOR. Soedergard, B. M. Canadian Patent 863,547. 9 Feb 1971. Priority date 25 Apr 1967, Sweden.

A nuclear reactor consists of a vessel with a reactor core inside and square core support block means arranged in an edge to edge relationship to form a flat bottom for the core. Vertical tubes are provided and each of the block means are carried by the upper ends of the vertical tubes. A bottom part of the reactor vessel supports the vertical tubes at least indirectly from beneath. Several control rods are provided and each vertical tube constitutes a guide tube for a control rod which is vertically movable in the guide tube and has a cruciform cross section. The reactor comprises several vertical fuel assemblies having bottom parts, and each of the block means has a central cruciform slot for admitting passage of the control rod and four through holes arranged in the four corners of a square for receiving the bottom parts of four of the vertical fuel assemblies and supporting them. Each control rod guide tube has at its upper end four depressions fitting against the cruciform slot, thereby forming two different flow paths for a coolant, one path leading from a space outside the guide tubes past the depressions, and up through the holes into the fuel assemblies, and the other path leading from the inside of the guide tubes up through the cruciform slots to a space outside the fuel assemblies. (Canada)

26082 INTERCHANGEABLE CONVEYING APPARATUS FOR PRESSURIZED VESSELS SUCH AS REACTORS. Eggmann, J.; Sidler, E. Canadian Patent 861,831. 26 Jan 1971. Priority date 22 Jun 1967, Switzerland.

An electric motor driving the impeller of a blower unit located at one end of the motor shaft is insertable in a guide sleeve extending through a wall of a nuclear reactor vessel. As the motor unit is pushed into the guide sleeve, the leading end of the blower unit engages and pushes back a spring loaded cover plate which had sealed the wall opening to prevent loss of pressure from the reactor vessel. When the combined motor and blower unit is withdrawn from the guide sleeve in the wall, the spring loaded cover plate automatically moves back into its sealing position. (Canada)

26083 AUTOMATIC SAFETY CONTROL OF NUCLEAR REACTORS. Leonelli, F.; Peterlongo, G. Com. Naz. Energ. Nucl., Notiz.; 16: No. 10, 121-5(Oct 1970). (In Italian).

The four classifications of malfunctions or operation incidents in nuclear reactors are described. Automatic devices in the reactor protection system are discussed, and their operation during the off-normal reactor conditions are described. (H.D.R.)

26084 CEA CONTRIBUTION TO THE DEVELOPMENT OF INSTRUMENTATION FOR REACTOR CONTROL. Furet, Jacques (CEA, Saclay, France). Ind. At.; 14: No. 9/10, 23-33 (Sep-Oct 1970). (In French).

The instrumentation units of the command control influence both the safety and financial viability of installations. The performances and characteristics sought are discussed. An up to date survey made by the CEA of these units in France is analyzed. Experimental results on the operational efficiency of these units confirm the reliabilities envisaged at the experimental stages. A development of this instrumentation is envisaged for new types of reactor, particularly those using ordinary water. Examination of this development indicates the necessity of launching into a new program providing manufacturers with the means of supplying materials which will be needed, and also the ability to compete in the international market. Present studies in the CEA laboratories are oriented in this direction. (France)

XUM

GENERAL

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Because of problems involved in the mechanical preparation of this index, all accent marks are omitted. The following changes in spelling have been introduced to reduce some of the confusion which might result from omitting the accents:

Germanic	ä	appears as ae
Germanic	ö	oe
Germanic	ü	ue
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SUBJECT INDEX

Cross references are included in cumulative subject indexes and in *Subject Headings Used by the USAEC Division of Technical Information* (USAEC report TID-5001).

The reader is also referred to *Guide to Abstracting and Indexing for Nuclear Science Abstracts* (USAEC report TID-4576).

Most headings in the subject index are specific materials, things, and processes. The headings are followed by modifiers that describe the properties of, or processes applied to, the headings.

All index entries cite *NSA* volume and abstract numbers; volume number precedes the colon and the abstract number follows it. The designation (R) following the abstract number indicates a progress report; (P) indicates a patent; and (T) indicates a translation. Abstracts for reports other than progress reports carry no letter designation. Report numbers, where applicable, are included in parentheses after the abstract number of the citation. Published literature (journal article or book) can be identified by the absence of a report number.

Ideas presented in the original literature, rather than key words, have been indexed. The indexers have selected what seemed the most probable and logical place to look for typical information. Since it is not always possible to anticipate where a user would look for information, the cumulative indexes include numerous cross references. Consideration of synonymous or closely related terms will prove valuable.

Information is indexed for the greatest use to the greatest number of users. This requires that a topic be indexed to headings that most specifically describe it and not ordinarily to the headings that describe its ultimate use or to the general class headings that include the specific headings. For example, information on boiler design for the Fermi Fast Breeder Reactor would be indexed under the headings BOILERS and FERMI FAST BREEDER REACTOR but not necessarily under the headings REACTORS, FAST or REACTORS, BREEDER.

General or broad headings are reserved for general summaries, reviews, comprehensive reports, and similar literature.

Subject Heading Styles

Generally, the direct form of subject entry is used rather than inverted headings; e.g., AMINO ACIDS rather than ACIDS, AMINO; HELIUM ISOTOPES He-4 rather than HELIUM—ISOTOPES He-4 or HELIUM—He-4 ISOTOPES. Note, however, that in some cases parenthetic modifying terms or inverted headings such as NEUTRONS, FAST, are used where the alphabetical arrangement of a direct entry would cause information to be scattered. In addition, organic compounds are usually entered in the index in the inverted form to facilitate grouping like or related compounds with the parent compounds; e.g., BENZENE, BROMO- rather than BROMOBENZENE. In general, the nomenclature used is that of the subject indexes to *Chemical Abstracts*.

Alphabetization

Subject headings are alphabetized word by word. Parenthetic qualifiers, numbers, and Greek letters within subject headings are disregarded in alphabetizing unless there are two or more headings that are otherwise identical, in which case the qualifier, numerical progression, or spelled names for the Greek letters determine the order.

Examples:

M-Capture
  see ELECTRON CAPTURE
MAGNESIUM
MAGNESIUM ALLOYS AND SYSTEMS
MANGANESE FLUORIDES
MANGANESE FLUORIDES MnF_2
MESONS
MESONS (π)
MESONS (ρ)
1-PENTANOL
2-PENTANOL

Modifying Phrases

The modifiers appearing under a subject heading are written specifically to show the relation between the item being indexed and the heading. The modifier therefore contains a maximum of useful information. Although the modifier begins with the word judged to be of greatest use to the greatest number of users, there is still need for the searcher to consider all modifiers under the heading(s) of interest.

Modifiers usually form meaningful phrases when combined with the subject heading. Some are intended to be read following the subject heading, e.g., the entry HYDROGEN—sorption by charcoal should be read "hydrogen sorption by charcoal." As a result of placing the important word first, however, many modifiers must be rearranged for smooth reading, e.g., FORMALDEHYDE—yields in radiolysis of ethyl ether, effects of deuterium on, should be read "effects of deuterium on formaldehyde yields in radiolysis of ethyl ether" and URANIUM—crystal structure of, effect of cooling rate on allotropic transformations in, should be read "effect of cooling rate on allotropic transformations in crystal structure of uranium."

Special characters are added to modifiers in the fields of physics and reactor technology; if the modifier does not establish the experimental or theoretical character of a reference, a symbol (E), (T), or (E/T) is placed immediately after the modifying phrase and before the abstract number.

Physical States and Configurations of Materials

The specific physical state, if other than normal, or the geometric configuration of the material is included in the modifying phrase; e.g., information on liquid metals is indexed under the specific metal with "liquid" in the modifier and carbon crucibles is indexed under CARBON with "crucibles" appropriately placed in the modifier. The information on carbon crucibles is also indexed under CRUCIBLES.

Nomenclature of Inorganic Compounds

Inorganic compounds are indexed to subject headings in the direct form. Cations are listed in the order of increasing valence for polycationic salts of varying valence and in alphabetic order for polycationic salts in which all cations have the same valence; e.g., SODIUM ALUMINUM SILICATES and POTASSIUM SODIUM SULFATES. If more than one anionic species is presented in a compound, the anions are arranged alphabetically, e.g., BERYLLIUM FLUORIDE HYDROXIDES.

Nomenclature of Organic Compounds

Organic compounds are indexed by subject headings based on the indexes to *Chemical Abstracts* except in the area of enzymes, in which specific enzymes, named according to the 1964 recommendations of the International Union of Biochemistry, are used. In many cases nonproprietary names for drugs are used as subject headings, and cross references are made from the systematic chemical names. Subject headings for hormones appear in the inverted style at HORMONES.

Nomenclature of Life Sciences

Subject headings for plants are names of phyla with one exception: members of the Phylum Tracheophyta are indexed under class or subclass names. Scientific names (genus and species) are used as the initial, or file, word in the modifying phrase. Scientific names are omitted only when the name is not available in the literature or cannot be found in available references.

Subject headings for animals are the names of phyla with the following exceptions: (1) members of Phylum Arthropoda and Phylum Chordata are indexed under appropriate class name, and (2) common names are used for members of Class Mammalia.

Subject headings are entered for various classes of commodities, and specific products are identified in the file-word position of the modifier. In the following examples, approved subject headings are capitalized and typical modifier file words are listed in lower case.

Example 1	Example 2
CEREALS	MEATS
bread	beef
flour	fish
oats	mutton
rice	pork
rye	poultry
wheat	seafood

Diseases, pathological conditions, and in vitro studies of atypical cells and tissues are indexed under subject headings for the organism affected, under the appropriate anatomical structure of physiological phenomenon affected, and under the appropriate disease heading. Subject headings for diseases (defined as any deviation from the norm) are DISEASES; DISEASES, INFECTIOUS; DISEASES, NEOPLASTIC; DISEASES, PHYSIOLOGICAL; DISEASES, PLANT; and DISEASES, TRAUMATIC.

Diseases of mixed etiology are treated in the following manner: neoplastic diseases that are also classified as infectious or physiological are indexed under DISEASES, NEOPLASTIC; diseases in which a microorganism is the etiologic agent are classified under DISEASES, INFECTIOUS; physiological anomalies that are neither neoplastic nor infectious are indexed under DISEASES, PHYSIOLOGICAL; the acute radiation syndrome, nonspecific radiation injuries, trauma, and wounds or incisions inflicted mechanically are indexed under DISEASES, TRAUMATIC.

Specific diseases or pathological conditions are named in the file-word position of the modifier, in the author's terminology, and are set off from the remainder of the modifier by commas. Neoplasms are designated as benign or malignant in the file-word position when more specific information is not available.

Multicomponent Alloys and Other Systems

Multicomponent alloys and systems, except well-known trade names, are indexed under a subject heading for each component in the form "element systems" for nonmetals or "element alloys and systems" for metals. The modifier begins with element symbols for each component arranged alphabetically. In addition, if significance is placed on the base metal of the alloy, this is indicated by adding "-base" to the element symbol.

Example: A 1.5C, 12Cr, 0.25V, 0.8Mo, bal Fe alloy is indexed as

```
CARBON SYSTEMS
  C--Cr--Fe-base--Mo--V, ...
CHROMIUM ALLOYS AND SYSTEMS
  C--Cr--Fe-base--Mo--V,...
IRON ALLOYS AND SYSTEMS
  C--Cr--Fe-base--Mo--V, ...
MOLYBDENUM ALLOYS AND SYSTEMS
  C--Cr--Fe-base--Mo--V, ...
VANADIUM ALLOYS AND SYSTEMS
  C--Cr--Fe-base--Mo--V, ...
```

Well-known alloys, such as ZIRCALOY-2, are indexed under the trade name; cross references from each component of the alloy to the trade name appear in cumulative indexes.

Multicomponent systems in which nonmetallic elements are present in large percentage and which are commonly referred to as systems or mixtures are indexed in a manner similar to alloys.

Example: A tungsten–silicon preparation is indexed as

```
TUNGSTEN ALLOYS AND SYSTEMS
  Si--W, ...
SILICON SYSTEMS
  Si--W, ...
```

Multicompound systems and mixtures of inorganic compounds are indexed under the subject heading for each component compound; the modifiers begin with an alphabetical listing of compound formulas.

Example: A lead titanate–lead zirconate mixture is indexed as

```
LEAD TITANATES
  PbTiO3--PbZrO3
LEAD ZIRCONATES
  PbTiO3--PbZrO3
```

A mixed system of compounds and elements is indexed by a combined form of the preceding conventions; e.g., a dispersion of copper and alumina would be indexed as

ALUMINUM OXIDES
  Al_2O_3--Cu, ...
COPPER ALLOYS AND SYSTEMS
  Al_2O_3--Cu, ...

Mixtures of organic compounds are indexed under subject headings for each component of the mixture; the modifiers begin with an alphabetical listing of compound names.

Example:

ACETIC ACID
  acetic acid--BF_3, ...
BORON FLUORIDES
  acetic acid--BF_3, ...

Example:

BENZENE, CHLORO-
  bromophenol--chlorobenzene, ...
PHENOL, BROMO-
  bromophenol--chlorobenzene, ...

If modifiers for alloys and systems are included with other modifiers under the same subject heading, they are filed last.

Example:

CARBON SYSTEMS
  deposition on nuclear fuel particles
  molecular structure of
  neutron total cross section for
  sorptive properties for xenon
  Young's modulus for
  Al--C--Cr, superconductivity in
  B--C, phase studies for
  C--U--Zr, fabrication and physical properties of

Nomenclature of High Energy Physics

Information on particle-particle events is indexed under subject headings for the specific particles involved. The modifier file word *interactions* is followed by the specific interaction written in symbolic form. Particle nomenclature and symbols follow that of Rosenfeld, et al. *Data on Particles and Resonant States*, UCRL-8030 (latest revision). For consistency the incident particle is always written first. The mass (in MeV) of a resonance state is included in parentheses after the symbol to avoid ambiguity. Hyperfragments are indicated in modifiers as in the following examples: Λ-He^5, Σ-H^3, $\Lambda\Lambda$-Be^{10}. The superscript on the right indicates the total number of baryons in the composite system.

Examples:

MESONS (π^-)
  interactions $\pi^- + p \rightarrow \Lambda + K^+ + \pi^-$ at 6 GeV/c in hydrogen bubble chamber, $\Lambda K(1700)$ enhancement in, (E)
BARYONS, RESONANCE (N^*)
  production of $\Delta^{++}(1236)$ and $\Delta^0(1236)$ from $K^- + p \rightarrow K^- + p + \pi^+ + \pi^-$ interactions at 2.63 and 2.70 GeV/c, (E)
HYPERFRAGMENTS
  binding energy of $\Lambda\Lambda$-He^6, three-body α--Λ--Λ model for

Subject headings are also provided for specific models and theories.

Examples:

ELEMENTARY PARTICLE MODELS (TRIPLET)
  hadron total cross sections in quark, numerical analysis of
CURRENT ALGEBRA
  PCAC hypothesis for A_1 and rho dominance in $\pi \rightarrow e + \nu + \gamma$ decay
REGGE POLE THEORY
  predictions for polarization in $K^- + p \rightarrow$ anti $K^0 + n$, $\pi^- + p \rightarrow \pi^0 + n$, and $\pi^- + p \rightarrow$ eta + n interactions at high energies
SYMMETRY GROUPS
  SU(2) × SU(4) intermediate-coupling model for nucleon and hyperon isobars

Nomenclature of Reactor Technology

Subject headings for reactors are of three types:

(1) Specific reactors, e.g., ARGONNE RESEARCH REACTOR, SAXTON POWER REACTOR

(2) Reactors having a common physics or engineering characteristic, e.g., REACTORS, FAST; REACTORS, ORGANIC-COOLED; REACTORS, PRESSURIZED-WATER

(3) Reactors having a common purpose, e.g., REACTORS, POWER; REACTORS, RESEARCH

Information on specific reactors, type (1), is indexed under the one specific subject heading. Information on classes or types of reactors, types (2) (characteristics) and (3) (purpose), is indexed under all applicable headings. For example, information on a heavy-water-moderated organic-cooled power reactor is indexed under REACTORS, HEAVY WATER-MODERATED; REACTORS, ORGANIC-COOLED; and REACTORS, POWER.

Subject headings exist for selected reactor components, e.g., REACTOR FUEL ELEMENTS. When applicable, headings for components are indexed even though they may have been included in a modifier under a type (1) or (2) heading. The materials in reactor components are indexed when the information is peculiar to the material.

Modifier file words under reactor headings are of two primary types: one type expresses reactor characteristics, e.g., reactivity; the other, components, e.g., control rod. If no subject heading appears for a reactor component, the heading REACTORS is used, and the component is used as the modifier file word.

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Published conference proceedings as well as individual unpublished papers from conferences are included in this index. A CONF number is assigned to the conference if published proceedings are received and also if only a single paper is received. The base number used is year-month-sequence. Thus, the number CONF-650101 indicates that the conference was held in 1965, in January, and that this was the first January 1965 conference so received. This number would be assigned to complete published proceedings. If individual papers are received, the base number is extended to include a paper number, e.g., CONF-650101-1. As additional papers are received, they will be assigned consecutive numbers in the series, CONF-650101-1, CONF-650101-2, etc. This numbering system ensures that all papers received from a conference will be associated with that conference in this index.

If published proceedings are received after the receipt of individual papers, the complete proceedings will be abstracted and the abstract number will appear in this index with the base CONF number.

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2 25-24963 Ann. Geophys.; 26: 427-42(1970)

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